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Insect Management For Desert Lettuce Production

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Introduction

Desert lettuce production remains highly dependant on the availability of effective and economical insecticides. The implementation of FQPA has begun and will likely result in the reduced availability of many important compounds. Consequently, development of new IPM alternatives for insect management has become especially important. Recent product registrations have resulted in important IPM tools for desert lettuce growers that provide excellent control of worms, *leafminers*, and whiteflies. There are several additional chemistries currently under development that will be available for insect management in the next few years. Research to evaluate and develop these products for desert lettuce IPM programs has been supported through funding provided by AILRC and the Agrochemical industry over the past several years.

However, thrips and aphids still remain key pests of spring lettuce in the desert and represent the most important insect problems currently facing the industry. Several new promising insecticides that are in early stages of development are being evaluated for their control. However, the presence of a new aphid species, the currant-lettuce aphid, *Nasonovia ribisnigri*, and the foxglove aphid, *Aulacorthum solani*, presents some new challenges. We are still uncertain how this new species will behave under desert growing conditions. Research to learn more about its damage potential and control in the desert needs to continue. Furthermore, western flower thrips remain a very difficult pest to control and no compounds are being developed specifically for its management. Many of the compounds currently used for controlling thrips (Lannate, Orthene, Dimethoate) are directly threatened by FQPA. The intention of this proposal is to continue evaluation of new chemistries and management approaches under local growing conditions and generate new information that will allow Arizona growers to cost-effectively manage these pests.

Aphids are one of the most important insect problems in head lettuce grown in Arizona. A new aphid species, the foxglove aphid, *Aulacorthum solani*, was found infesting commercial lettuce fields in the Yuma area for the first time this past growing season. It has been known to occur in California since at least 1940, and along with the lettuce aphid, *Nosanovia ribis-nigri*, has caused problems for lettuce growers in Salinas area for the past several years. Although, the lettuce aphid is the more important of the two in Salinas, studies last spring suggest that foxglove aphid may be a more important pest in the desert. Foxglove aphids are thought to occur throughout the U.S and Canada, but its effect is generally greatest in the eastern regions of the continent. It is also found worldwide, but is probably of European origin.

The foxglove aphid appears to be similar to the lettuce aphid in that the alates (winged forms) are difficult to differentiate, both aphids have short life cycles that allow populations to build up rapidly, and both tend to prefer to colonize the youngest tissue near the terminal growing point of the plant. Apterae (wingless forms) foxglove aphid are also often confused with the green peach aphid, *Myzus persicae*. Both aphids are usually yellow-green to all green but the green peach aphid may also be somewhat pink or red, as is the lettuce aphid. The foxglove aphid is slightly larger (maximum length is 3.0 mm) than the green peach aphid (max. length is 2.3 mm). One way to distinguish these two aphids is by the dark joints found on legs and antennae of the foxglove aphid, and the dark tips of the cornicles. The green peach aphid also has pale-colored legs and antennae but without dark joints. Foxglove aphids are also unique in that they have a bright green or dark colored spot at the base of each cornicle. Alates have a pattern of transverse dark bars on the dorsal abdomen.

The foxglove aphid was not previously thought to occur in Arizona. It is principally considered a serious pest of potatoes and is also found on ornamental and greenhouse plants. It is considered an occasional pest of lettuce and leafy vegetables grown in Canada. Unlike the lettuce aphid which was first found in Yuma five years ago, the foxglove aphid is known to colonize a much broader range of plant hosts, including a wide variety of weeds, ornamentals and crops. This large availability of hosts and apparent adaptation to our winter and spring growing conditions suggests that foxglove aphids might present growers with some new challenges.

There is much uncertainty surrounding this new species, and its ability to thrive within our desert growing conditions. We are not sure how or when the foxglove aphid moved into the Yuma area, but it seems likely that it may have arrived via transplants or harvest equipment, much like we suspect with the lettuce aphid. Because this species is polyphagus and utilizes a number of known host plants grown in the desert, we are concerned that foxglove aphids may become an established pest on our winter/spring crops. In terms of management, control with foliar aphicides appears to be more difficult because the aphids preference for the protected terminal growth. We have had the opportunity to conduct a considerable amount of field research over the past two growing seasons to learn more about this pest. Because of the importance of the foxglove as a contaminant of lettuce and other leafy vegetables, we designed several studies to its examine its population growth, distribution, and damage potential.

Objective 1. To continue monitoring for a 10th consecutive year the commercial field performance of Admire soil treatments for control of whiteflies in the Yuma area.

Methods and Materials : Several commercial lettuce fields planted in the Dome Valley, Gila Valley and Yuma Valley were used for these studies from 1993-2000. A total of 8 monitoring sites were initially established for each season, but due to weather and other problems associated with stand establishment the actual number of fields varied each year (Table 1). Lettuce fields were planted within a week in early September (Sep 9-17) in each year. Admire was evaluated on 'empire' type lettuce varieties each year. Three treatments were evaluated in each growers field: (1) growers standard application of Admire throughout the field, (2) a surface banded application of Admire applied over each seedline immediately following planting and before sprinklers were set , and (3) an untreated check plot. The surface banded treatment and untreated check plot were placed adjacent to each other within untreated areas of each lettuce field. All plots were 4 beds wide by 75- 150 ft long with 1_3 replications per field. The commercial standard fields and surface band treatments received 16 oz of Admire at planting in a total volume of 10 gallons/acre. Admire was injected at a depth of 1.5 - 2" below the seed line just prior to seeding. The surface band was 3" wide and applied directly over the seedline.

Lettuce plants were sampled for immature whitefly densities three times each season, based on crop phenology. Twenty basal leaves from the center rows of each plot were collected randomly from ten lettuce plants at: thinning stage (4-leaf stage; 21 days after planting), heading or "rosette" stage (leaves begin to cup inward to form heads; 50 days after planting), and harvest (mature heads; 69-77 days after planting). Samples were taken to the laboratory where two 1-cm^2 areas were selected randomly on each leaf, and the numbers of all immature stages of whiteflies were counted using a stereo microscope and recorded. Lettuce yields were taken from three m of one bed of each plot just prior to commercial harvest operations. Weight (kg) and diameter (cm) were measured for each head and averaged for each plot.

Since 1998, studies similar to above were initiated in commercial broccoli and melon fields in the Yuma and Gila valleys. Broccoli plots were established in early September similar to the lettuce trials described above. Four of the experimental field sites were in the Yuma valley and one was in the Gila Valley. Admire was applied similar to the lettuce trials. Leaf samples were collected from basal leaves at 30 and 50 days after planting and immature densities were assessed as above. Melons plots were established in mid-August and conducted in drip irrigated commercial fields located in the Yuma Valley. Untreated plots consisted of a single row within each field, 300-600 ft in length. Admire was applied to the field after seedling emergence (1-2 true leaves) by injecting a 16 oz/acre rate through the sub-surface, drip irrigation lines located 8" below the seed line. Untreated beds were established by closing off the drip line during the injection period, then allowing water to flush the system for several hours. The drip line was reattached the next day and irrigation commenced in both treatments. Leaf samples were collected from crown (nymph estimates) and terminal (egg estimates) leaves at 25, 40 and 60 days after planting and immature densities were assessed as above.

Results : Evaluations of Admire field efficacy in each field for the 2002 growing season are found in Figure 1. Whitefly densities for the surface band application are not shown because they were not different from the growers at-plant Admire application during these studies. The purpose for using the surface band application of a precise rate of Admire was to detect if the growers standard was misapplied or if Admire was actually losing efficacy. Based on our observations, neither event occurred. Similarly, whitefly estimates at harvest are not presented because low densities were observed at harvest and did not differ between treatments. Consequently, yield difference were not observed.

Over the past 10 years, silverleaf whitefly densities in lettuce fields have declined dramatically. Numbers were greatest in 1993 and 1994 when Admire was first introduced (Fig 1). Untreated lettuce plots had significantly greater whitefly densities throughout the season and lower yields than the Admire treated field plots . During the past 8 years (1995-2002), whitefly densities have overall been considerably lower. Although, in most years, whitefly numbers were significantly

greater in the untreated plots, immature densities at thinning and heading were not great enough to cause differences in yield. A trend of low whitefly abundance and immigration during September in Yuma growing regions has been observed in particular the past 3 years, and can be seen more directly from trap catches in our trap network . In my estimation, this is largely a reflection of the area-wide use of Admire on fall and spring vegetable crops and the suppressive effects it has had on whitefly populations. In addition , the implementation of the IGR's, Knack and Applaud, in cotton and the additional impact that natural mortality has had whitefly populations has undoubtedly had an impact on regional whitefly activity, particularly as it relates to adult movement form cotton to fall lettuce crops.

In general, our data suggests that Admire continues to provide exceptional field efficacy over the past 8 years. Thus, as of the fall 2002 our initial conclusion is that Admire remains highly efficacious. However, the fact that densities on lettuce have been very low (#2 nymphs/cm^2) since 1995, and lettuce is a marginal host for whitefly development and colonization, suggests that these data may not truly reflect Admire efficacy against whitefly populations in Yuma. Because of this concern, untreated test sites were established in commercial broccoli fields beginning in the fall 1998 to measure differences in whitefly colonization in these highly preferred host crops.

Results from the broccoli trials clearly show that Admire provided excellent efficacy of whitefly adults and small nymphs (Figure 2) . No significant colonization was observed in any of the Admire treated fields. In contrast, several of untreated plots experienced stunted growth, and chlorosis of leaf and stem tissue. Result in the melon plots showed a similar response . Field plots left untreated, resulted in significantly higher whitefly densities at each sampling interval. These results are consistent with results from our 1998 studies, suggesting that growers could expect 45-60 days of residual efficacy following soil application of Admire on fall vegetables. Furthermore, whitefly populations in Admire treated fields required no additional foliar treatments for whitefly control at or during harvest, whereas, plants in 1 of the 3 check untreated plots (Ranch 95) experienced vine collapse, sooty mold contaminated melons and reduced fruit size.

Table 1. Location of commercial lettuce fields used for monitoring efficacy of Admire against silverleaf whitefly

	Number of monitoring sites		
Year	**Yuma Valley**	**Gila Valley**	**Dome Valley/Roll**
1993	0	1	4
1994	2	1	4
1995	1	0	6
1996	2	2	2
1997	2	2	1
1998	2	2	4
1999	2	2	1
2000	3	2	0
2001	2	2	2
2002	4	0	1

Figure 1. Silverleaf Whitefly Nymph Densities on Lettuce Leaves at Thinning (A) and Heading (B) Collected from Several Commercial Lettuce Fields in Yuma, AZ, 1993-2002.

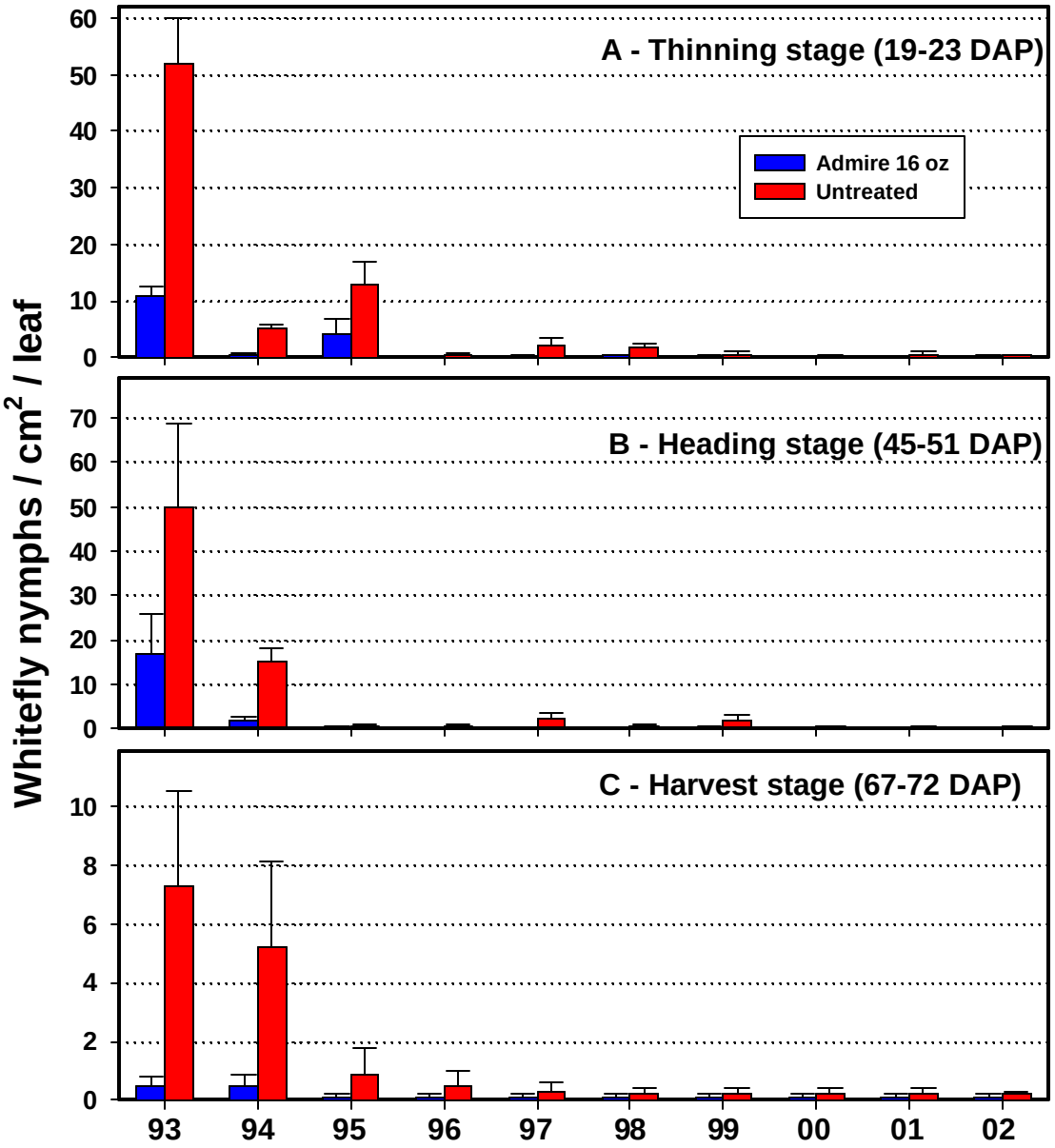
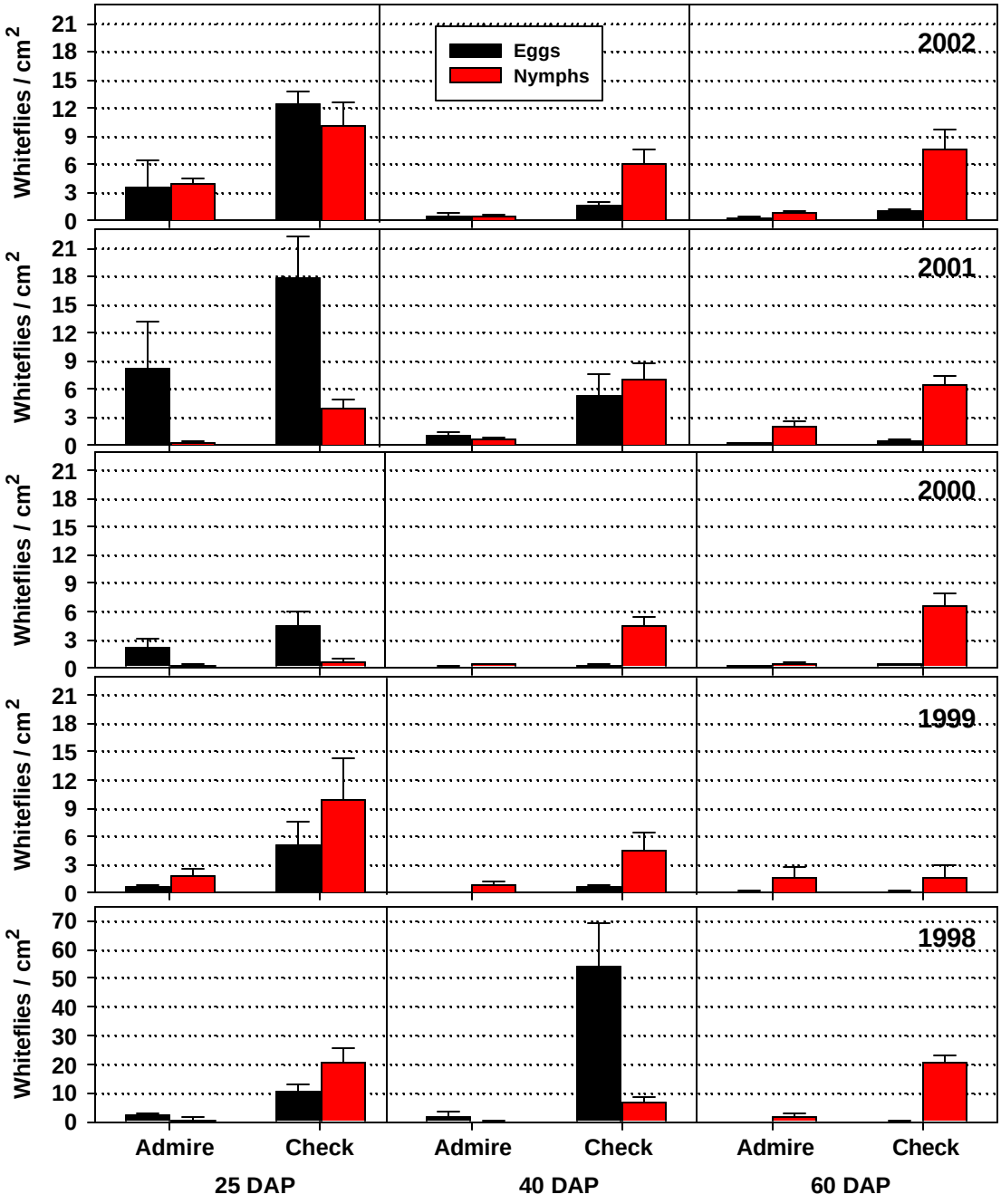


Figure 2. Silverleaf Whitefly Nymph Densities on Leaves Collected from Commercial Broccoli Fields at 25, 40 and 60 DAP, Yuma Az, 1998-2002.



Objective 2. To replicate studies to examine the population dynamics of Foxglove Aphids infesting head lettuce in the desert during the growing season.

Methods and Materials : The incidence and distribution of foxglove aphids in the Yuma growing area was measured in several different ways for this report. First, information describing seasonal aphid activity on an area-wide basis was generated from a network of yellow sticky traps that were monitored weekly from late August through March. We have been monitoring aphid activity since 1998 and have specifically been identifying foxglove and lettuce aphid species. Yellow sticky traps were located at several sites throughout Yuma County's vegetable growing areas. Three - five trapping stations were situated in the Yuma Valley, Gila Valley and Dome Valley/Roll areas for a total of 17 trap locations. In addition, in 2002 we situated traps along the Colorado River in the Yuma Valley. At least one location in each growing area was situated near an AZMET weather station. The approximate location of traps in each valley was selected with the assistance of local PCAs. At each site, a single yellow sticky traps was placed in an open area adjacent to or near a field where aphids were monitored. Traps were collected 1-2 times per week and replaced. Sticky traps were taken to the laboratory where all aphids were counted and recorded. Only 6 aphid species of aphid consistently identified (foxglove, lettuce, green peach, cabbage, potato, and cowpea aphids). Data from trap captures was converted to the mean number of winged aphids / trap/ day and presented in a graphic format.

Surveys of commercial lettuce fields were conducted in the 2002-2003 growing season to document the incidence of foxglove colonization. Working with cooperating growers, surveys were conducted from 20 Dec through 24 Feb in 1-7 fields per week. Both head lettuce and romaine were sampled and none of the fields surveyed had been treated with imidacloprid (Admire). Fields ranged from 9-22 acres in size and were located in the north Yuma Valley, south Yuma Valley, and Gila and Dome Valleys. On each survey date, 20 lettuce plants in a single location per in each surveyed field were randomly selected and sampled for the presence of foxglove aphids. Each plant was sampled by visually examining all plant foliage and estimating the number of alate and apterous aphids present. The number of infested fields, percentage of infested plants and average number of aphids per infested plant were summarized for all fields surveyed on each sample date.

To examine the population dynamics and damage potential of foxgloves experimental field plots were established in head lettuce at the University of Arizona, Yuma Agricultural Center. Beginning in mid-October 1999, ¼ acre plots of head lettuce were planted on 2-3 week intervals. Table 4 provides the planting date and lettuce variety for each planting. On each planting date (wet date) lettuce was direct seeded into double row beds on 42 inch centers. Each planting was subdivided into 4 plots consisted of 4 beds, 150 feet long. Plots were arranged in a randomized complete block design with four replications. No insecticide applications were made during the study. Aphid populations were assessed by estimating the number of aphids/plant by taking whole plant destructive samples. On each sampling date, 10 plants were randomly selected from each plot and placed individually into large 4-gal tubs. Each plant was sampled by visually examining all plant foliage and counting the number of alate and apterous aphids present. At harvest, infestation levels of apterous aphids were estimated by randomly selecting 10 plants within each replicate, visually counting the number of aphids on frame/wrapper leaves and heads, and separately recording aphid numbers for each location. Weather data observed from the AZMET station at the Yuma Ag Center was used to examine the influence of temperature and rainfall on foxglove abundance and population growth.

Results : Light populations of foxglove aphids were first found colonizing untreated head lettuce in small experimental plots at the Yuma Agricultural Center (YAC) in the spring of 2001. Initially, the aphids were thought to be potato aphids, but were later identified as *A. solani*. This was further verified in the spring 2002 when aphids found on untreated experimental lettuce plots at YAC were identified as foxglove aphids. However, no foxglove aphid has been reported from PCAs or growers that season. Furthermore, winged alate aphids had not been found in the Yuma area for the past several years (Figure 1). In general, aphid flight activity as measured by sticky trap captures varies considerably throughout the region. The most consistent bimodal patterns are found in the Yu ma Valley. Most of the aphids captured on these traps consisted of a number of unidentified aphids, as well as those we identified (cowpea aphid, cabbage aphid and green peach aphid). In 2002,/2003 aphid numbers were relatively low in the Gila and Dome Valley growing areas and no foxglove alates were found on traps (Figure 2). However, aphid numbers were more abundant in the Yuma Valley, particularly near the Colorado River, where traps captures during the spring were much higher than other areas (Figure 3). Foxglove alates were found on traps in the Yuma Valley on 10 Dec at Ave I and 21st, and then again on 7 Jan at Ave F and Co. 14th . Foxglove aphids were found fairly regularly on traps placed on the Colorado river beginning on Jan 7. This occurrence coincides with unseasonable warm weather we experienced in January of 2003.

The first documented incidence of foxglove aphid colonies in commercial lettuce occurred on Nov 12, 2002 in the Yuma Valley (Ave. D and Co. 12th st.). A PCA discovered a small number of apterous foxglove aphids colonizing pre-harvest stage head lettuce. The field was located adjacent to a residential area with Pecans trees. The field had not been treated with Admire. Following treatment with a foliar insecticide, the aphids were not found again in that field. On Nov 20, a small number of apterous foxglove aphids were found on wrapper leaves of head lettuce that was being harvested in the Yuma Valley (Co. 13 and Ave F). This field was located within a ½ mile of a citrus orchard and had not been treated with Admire. Then on Nov 24, a single alate foxglove aphid was found on untreated head lettuce on Co. 15th near the west main canal and a pecan orchard. Similarly a few alate foxglove aphids were found on head lettuce on Co. 14th and Somerton Ave on Nov 27th. Again on untreated lettuce. We did not receive further reports from PCAs until January when foxglove aphids infestations were becoming more common throughout the Yuma Valley. Results of our field surveys of untreated lettuce showed that foxglove aphids were sporadic in the Yuma Valley throughout December, but became more consistent during January and February (Table 1). Surprisingly, foxglove aphids were not reported from PCAs in either the Gila or Dome Valley growing areas, nor were they found in our commercial field surveys.

In most cases, the commercial fields infested with foxglove aphids were near the Colorado River and/or adjacent to citrus orchards and residential areas. Unlike the lettuce aphid which was first found in Yuma five years ago, the foxglove aphid is known to colonize a much broader range of plant hosts (Table 2 and 3). These include a wide variety of weeds (i.e., shepards purse, ground cherry, pigweed), ornamentals (i.e., geraniums, gladiolas, verbena) and crops (i.e., cucurbits, beans, canola, spinach, citrus, safflower, tomatoes) that are commonly found throughout the growing region in cultivated fields, residential areas, or along the Colorado and Gila rivers. This large availability of hosts, available year round, could allow the foxglove aphid to become an established pest of lettuce and other leafy vegetables. However, why foxglove aphid was not found in the Gila and Dome Valley areas, given their similarity in host crops, is unclear.

Aphid populations in general were higher in 2003 than in the previous 10 years, based on a summary of small plot efficacy trials planted during mid-November (Figure 4). There does not appear to be a strong correlation with seasonal heat unit accumulation or rainfall. The peak in aphid number seen this past year was a result of a greater abundance of the green aphid complex (green peach aphid, potato aphid and *Acyrthosiphon lactucae*, a common aphid species found in Yuma) as well as a the emergence of the foxglove aphid (Figure 4 -7). Numbers of *A. lactucae* were very high this year, relative to previous years, peaking in mid-November and December wet dates (Figure 5). In contrast, green peach and potato aphid populations have been very light the past few years. Lettuce aphids also reached peak numbers in 2003 (Figure 6). Foxglove aphids numbers on untreated lettuce were also much higher in 2003 than in 2002 (Figure 7), peaking in the December 3 lettuce planting in both years.

Figure 8 shows a comparison among the aphid species in individual lettuce plantings last season. This data shows that the foxglove aphid appears to have a much broader range of activity in desert lettuce than the other species. Traditionally we have concluded that lettuce crops are susceptible to economic infestations from aphids when planted beginning in mid-November. Foxglove aphids last year were the dominant species in October plantings, particularly in the late October when populations reached levels exceeding 60 aphids/plant at harvest. Although the *A. lactucae* was the dominant species in the November and December plantings, foxglove aphid populations also reached high numbers, often reaching nearly 200 aphids / plant.

Based on our studies over the past several years we have also made some other interesting observation concerning aphids in lettuce. First, the high aphid densities occurring last season may have been influenced by both temperature and rainfall (Table 4). Temperatures were similar for each planting, averaging 58-59 F. Unlike the previous three years, the average max and min temperatures in 2002-2003 were fairly uniform for each planting, presumably causing little disruption in aphid population growth. Another interesting observation was the consistent amount of rainfall that was received during the last 4 planting windows, averaging well over an inch of rain. We have felt for years that rainfall benefited aphid abundance in desert lettuce production. Similarly the green aphid complex reached higher number in 2000-2001 under considerable rainfall. This data further support our contention that growers may be at more risk from aphid infestation during mild, wet winter conditions.

Another observation from last year concerned the distribution of foxglove aphids within lettuce plants. Table 4 shows the numbers of aphids on both heads and frame leaves measured at harvest. This data clearly shows that aphids caused economic damage (head contamination) to head lettuce in the November and December plantings in 2002-2003. However, more aphids were found on the frame and wrapper leaves (53 % in 2002, 68 % in 2003) than were found in the head at harvest (47 % in 2002, 32 % in 2003). This is quite different from the other aphid complexes. Lettuce aphids are consistently found in greater numbers in the head (>90%) and populations of green aphids are more commonly found on the frame (>75%). Foxglove aphids were found to colonize plants differently as well throughout the season. This aphid has a tendency to disperse widely within in the plant rather than forming close-knit colonies as green peach aphid and lettuce aphids do.

In conclusion, it now appears that foxglove aphids have become established pest of lettuce in the desert southwest. We have seen a progressive buildup each year of their number and now appear to be spreading throughout the Yuma growing area. The large availability of hosts and apparent adaptation to our winter and spring growing conditions suggests that foxglove aphids might continue to be present in our region. Although they have not been found in the Gila and Dome Valleys yet, the fact that many of the same host are available for colonization suggest that they will eventually show up in these areas. Similarly, management o foxglove aphids has not been well studied, in part due to its recent presence locally, but also because it is not usually considered a major pest of lettuce in other arts of the world. Efficacy trials from last season (see article in this volume of 2003 Vegetable Report) have shown that several registered insecticides provided adequate control of these aphids. However, there is still much we do not know about the biology and ecology of this aphid pest, but studies are planned for next season to learn more about this important pest of desert lettuce.

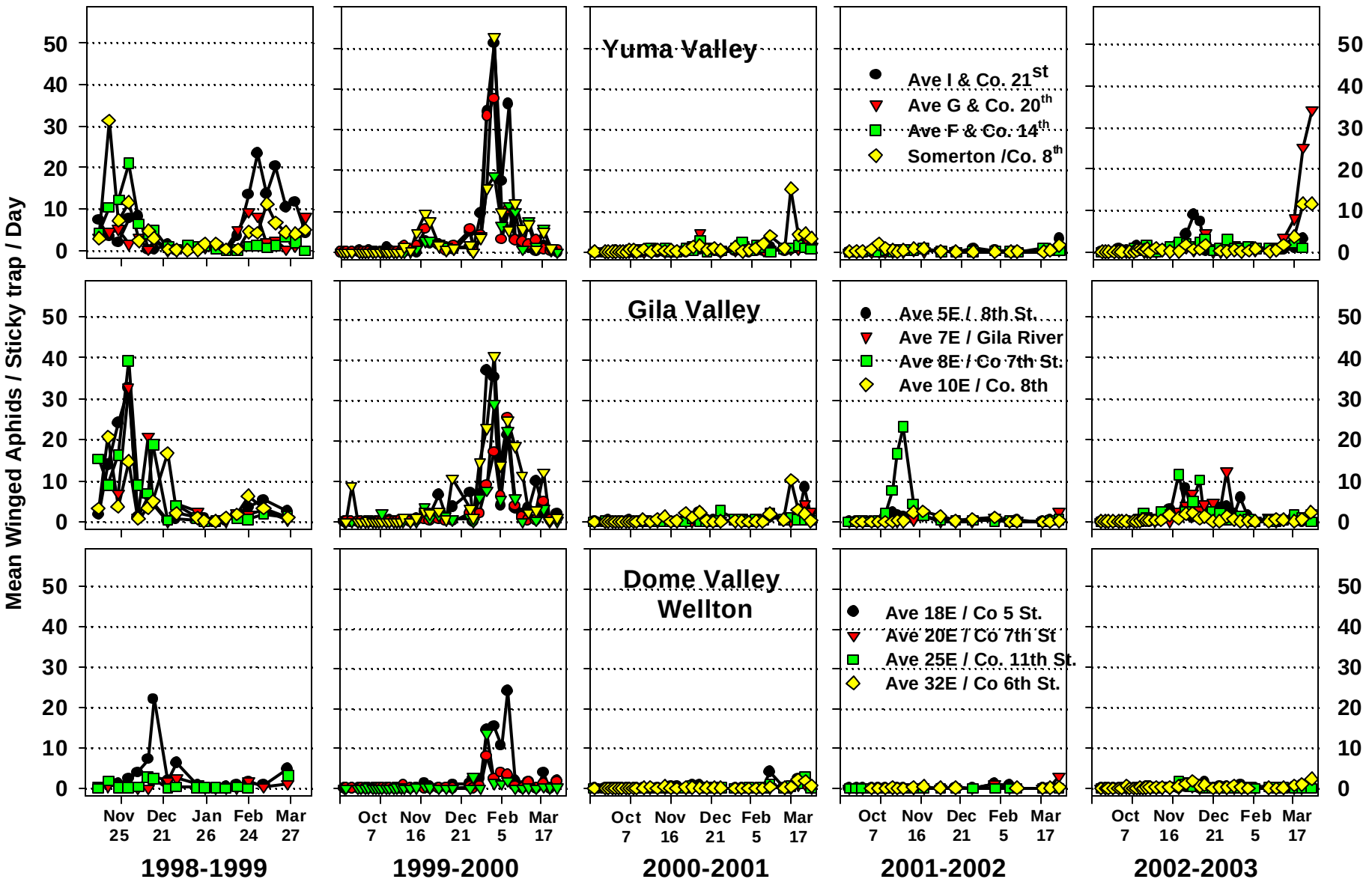


Figure 1. Seasonal aphid Flight activity as measured by yellow sticky traps during the produce season, 1998-2003 .

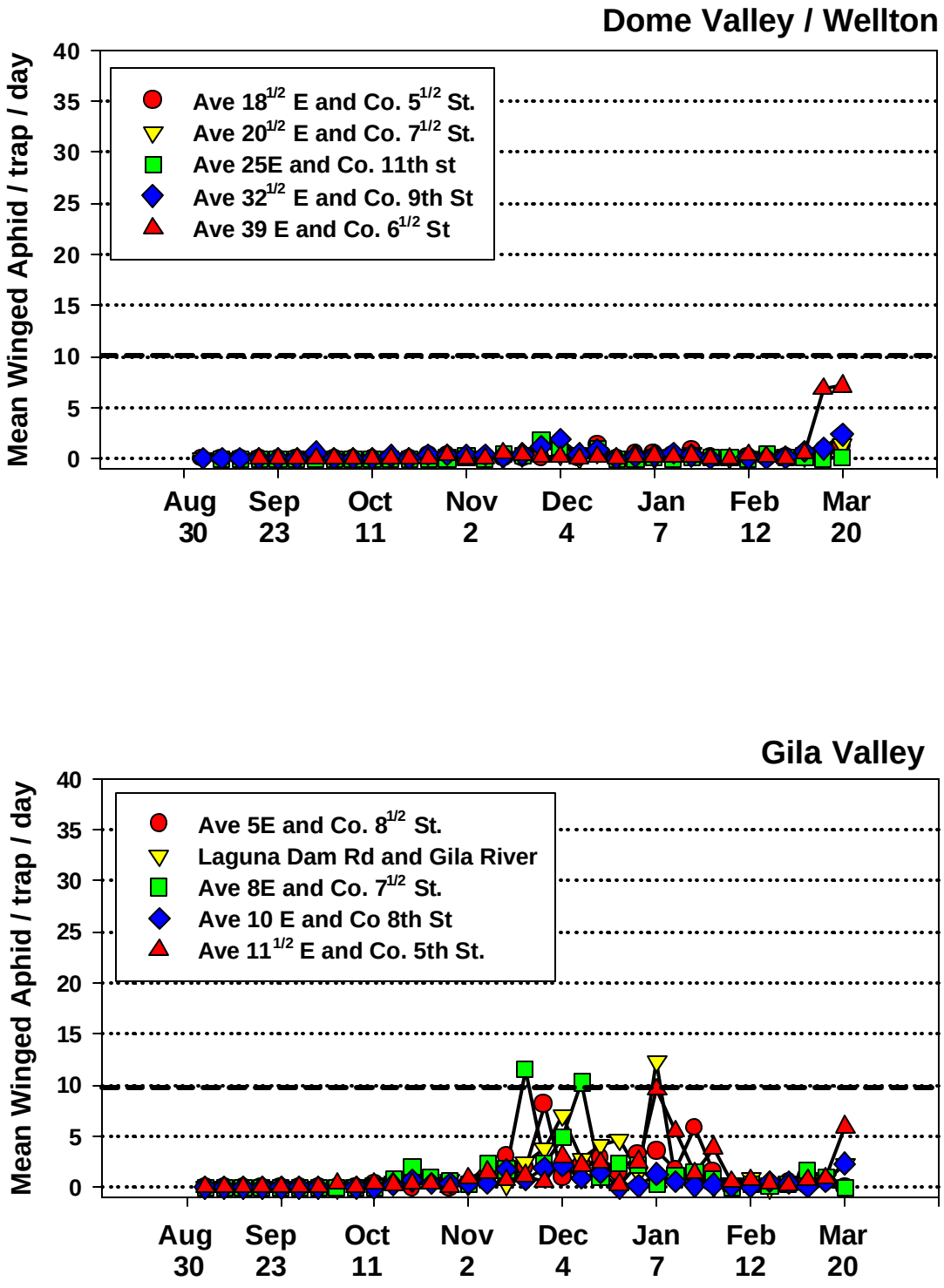


Figure 2. Seasonal aphid flight activity as measured by yellow sticky traps

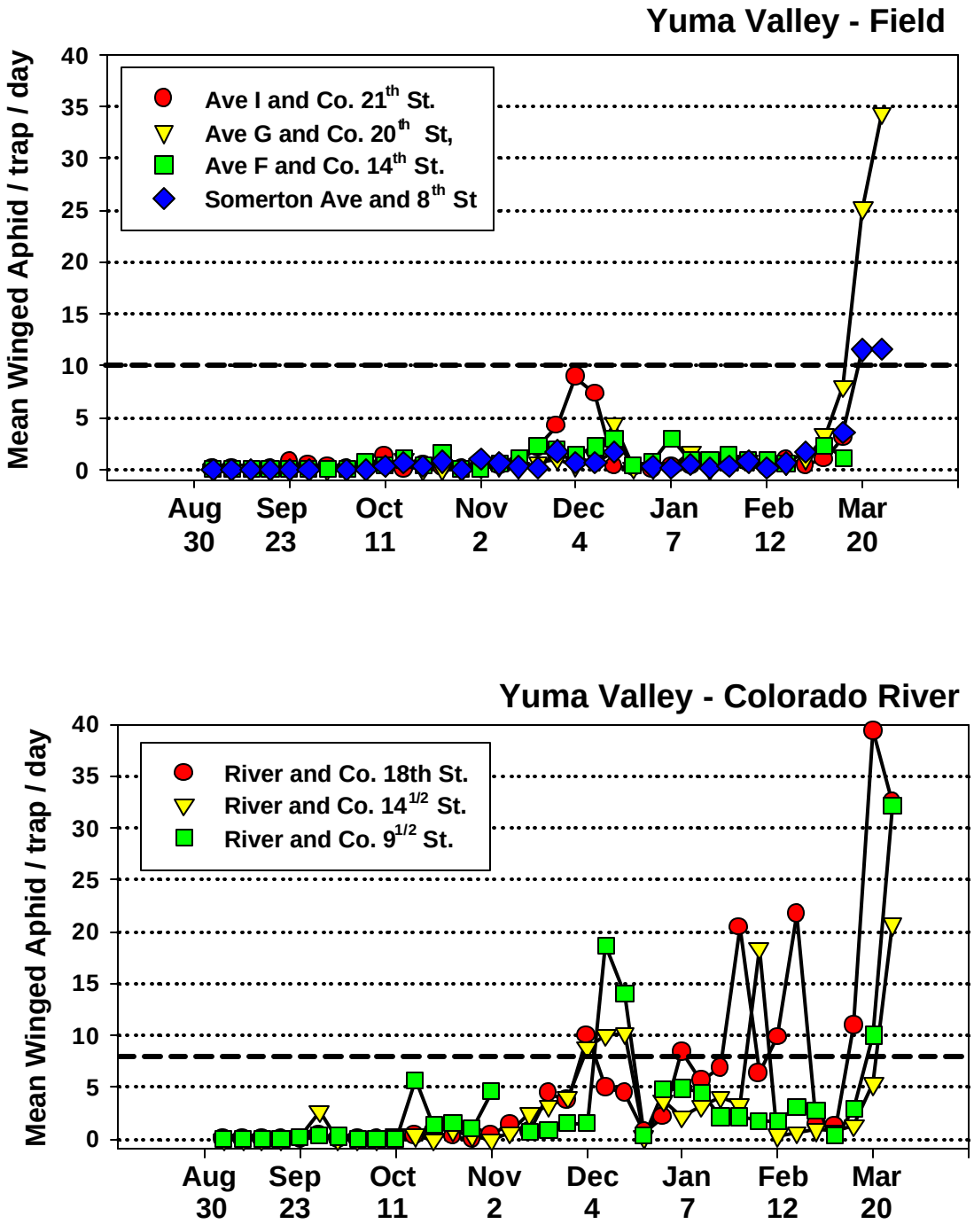


Figure 3. Seasonal aphid flight activity as measured by yellow sticky traps

Table 1. Results of surveys of commercial head lettuce and romaine fields for the presence of foxglove colonies, Yuma, 2002-2003

						Foxglove Aphid in Infested Lettuce Fields [b]			
			Plant	No. fields	No. fields	% infested plants		Avg. aphids/ infested plant	
Date	Location[a]	Crop	Stage	surveyed	infested	Winged	Non-winged	Winged	Non-winged
20-Dec	NYV	Romaine	Pre-harvest	4	1	10	10	1	2
27-Dec	SYV	Romaine	Harvest	3	0	0	0	0	0
27-Dec	NYV	Head lettuce	Harvest	3	0	0	0	0	0
31-Dec	NYV	Head lettuce	Harvest	3	0	0	0	0	0
31-Dec	NYV	Romaine	Harvest	2	1	0	5	0	5
31-Dec	SYV	Romaine	Pre-harvest	3	0	0	0	0	0
8-Jan	DG	Romaine	Harvest	6	0	0	0	0	0
8-Jan	NYV	Romaine	Harvest	3	1	0	5	0	3
8-Jan	NYV	Head lettuce	Harvest	1	0	0	0	0	0
15-Jan	NYV	Romaine	Pre-harvest	3	1	10	5	1-2	7
15-Jan	NYV	Head lettuce	Pre-heading	3	0	0	0	0	0
18-Jan	SYV	Romaine	Harvest	2	2	25-50	50-100	1-3	10-15
22-Jan	NYV	Head lettuce	Pre-harvest	4	1	0	20	0	20-25
22-Jan	NYV	Romaine	Pre-harvest	0	0	0	0	0	0
3-Feb	DG	Romaine	Pre-harvest	7	0	0	0	0	0
3-Feb	NYV	Romaine	Pre-harvest	4	2	10	15	1	1-5
10-Feb	SYV	Head lettuce	Harvest	2	1	70	70	>5	>50
10-Feb	NYV	Romaine	Pre-harvest	2	0	0	0	0	0
17-Feb	NYV	Romaine	Harvest	3	3	50-100	10-100	1-2	5-25
24-Feb	NYV	Head lettuce	Heading	2	1	0	20	0	5-10

[a] NYV=north Yuma Valley; SYV=south Yuma valley; DG= Dome Valley / Gila Valley

[b] Surveys consisted of sampling 20 plants in 1 location per field; averages reflect the estimated number of aphids found on the most infested plants

Table 2. List of plants that serve as hosts for common aphids found on desert lettuce.

Plant Host	Foxglove aphid	Green peach aphid	Potato aphid	*A. lactucae*	Lettuce aphid
Alfalfa	**U**	**M**			
Anise			**M**		
Artichoke		**M**			
Asparagus		**M**			
Beans		**M**	**M**		
Broccoli		**M**			
Sugar beets	**M**	**M**	**M**		
cabbage		**M**			
Carnations	**M**	**M**			
Carrot		**M**			
Cauliflower		**M**			
Celery	**M**	**M**	**M**		
Chick pea					
Chicory	**M**	**M**	**M**		**M**
Peppers		**M**	**M**		
Chrysanthumum	**M**	**M**	**M**		
Citrus	**M**	**M**	**M**		
Clover	**M**	**U**	**U**		
Cotton		**M**	**M**		
Cucumber	**M**	**M**	**M**		
Currant					**M**
Dill		**M**			
Egg plant	**M**		**M**		
Fennel		**M**			
Fig					
Gladiolas	**M**	**M**	**M**		
Grapes	**U**		**U**		
Peanut		**M**			
Iris					
Lettuce	**M**	**M**	**M**		
Lily	**M**	**M**	**M**	**M**	**M**
Lupin	**M**	**M**	**M**		
Corn	**M**	**M**	**M**		
Melons		**M**	**M**		
Canola		**M**			
Nectarine		**M**	**M**		

Table 2. continued

Plant Host	Foxglove aphid	Green peach aphid	Potato aphid	Lettuce seed-stem aphid	Lettuce aphid
Okra		**M**			
Orchids	**M**				
Parsley		**M**			
Parsnip		**M**	**M**		
Peas	**M**	**M**	**M**		
Peach		**M**			
Pomegranate					
Potato	**M**	**M**	**M**		
Pumpkin		**M**	**M**		
Quince	**M**	**M**			
Radish		**M**			
Rose	**U**		**M**		
Safflower	**M**	**M**			
Spinach	**M**	**M**	**M**		
Strawberry	**M**		**M**		
Tomato	**M**	**M**	**M**		
Tulip	**M**	**M**	**M**		
Turnip			**M**		
Vetch	**M**				
Watercress		**M**			
Watermelon		**M**			

M Reported to be a reproductive host based on the identification of apterous (non-winged) adults found colonizing on th host plant.

U Might be a reproductive host of aphid species

source: Blackman and Eastop 1984

Table 3. List of crop, weed, and ornamental plants that Foxglove aphid has reportedly been observed feeding on in California. (Essig 1947, Hilgardia 17: 597-616).

Weeds		Ornamentals	Crops
Ragweed	Creeping woodsorrel	Hollyhock	*Celery*
Pigweed	Ground cherry	Begonias	*Brassicas*
Camomile	Purslane	Chrysamthumum	Squash
Snapdragon	Curly dock	Foxglove	Pumpkin
Burdock	Silverleaf nightshade	Poinsettia	Strawberry
Milkweed	Annual sowthistle	Geranium	Soybean
Shepards purse	Dandelion	Gladiolas	Tomato
Lambsquarter	Common mullein	Lilies	Mint
Field bindweed		Orchids	Beans
Sunflower		Primrose	Peas
Henbane		Verbena	Potato
Purple deadnettle		Periwinkle	Eggplant
Henbit		Pansy	Clover
Sweet clover			

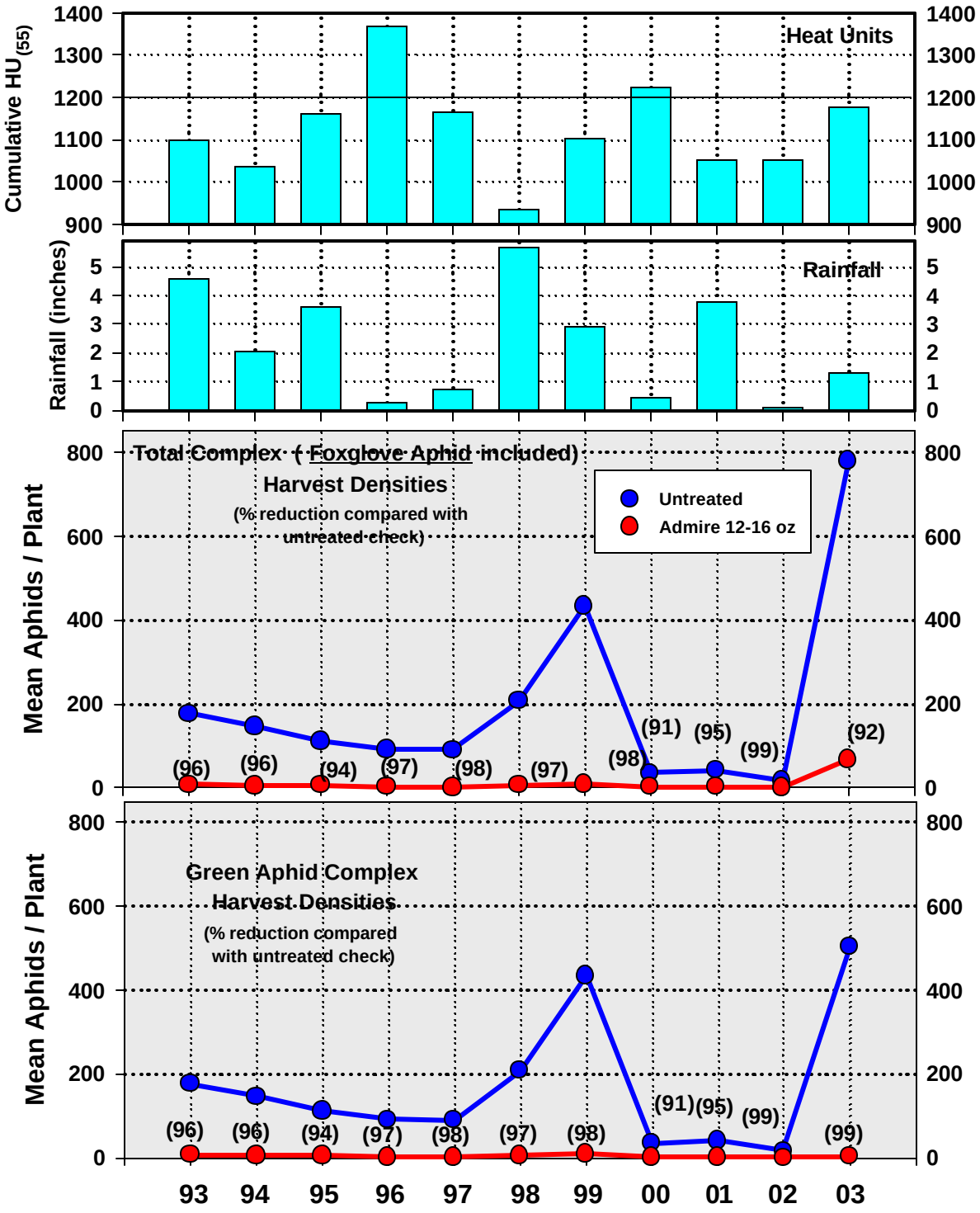


Figure 4. Average aphid abundance on Admire-treated and untreated head lettuce at harvest from 1993-2003. Data was summarized from 2-3 efficacy trials conducted exactly the same in each year where lettuce plots were planted during mid-November.

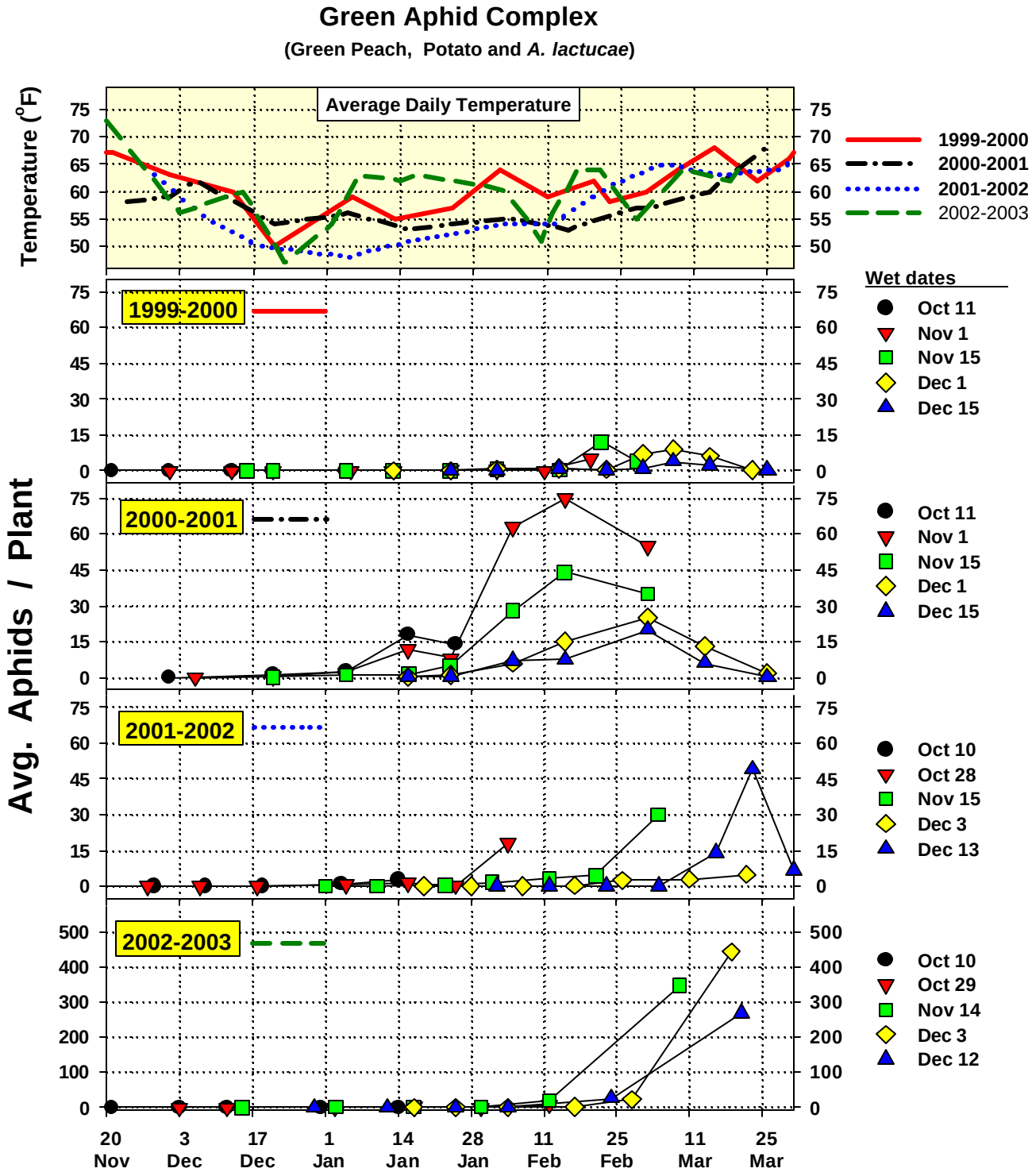


Figure 5. Average green aphid complex (green peach aphid, potato aphid and A. lactucae) densities on untreated head lettuce plots planted at intervals during the growing season, Yuma Agricultural Center, 1999-2003.

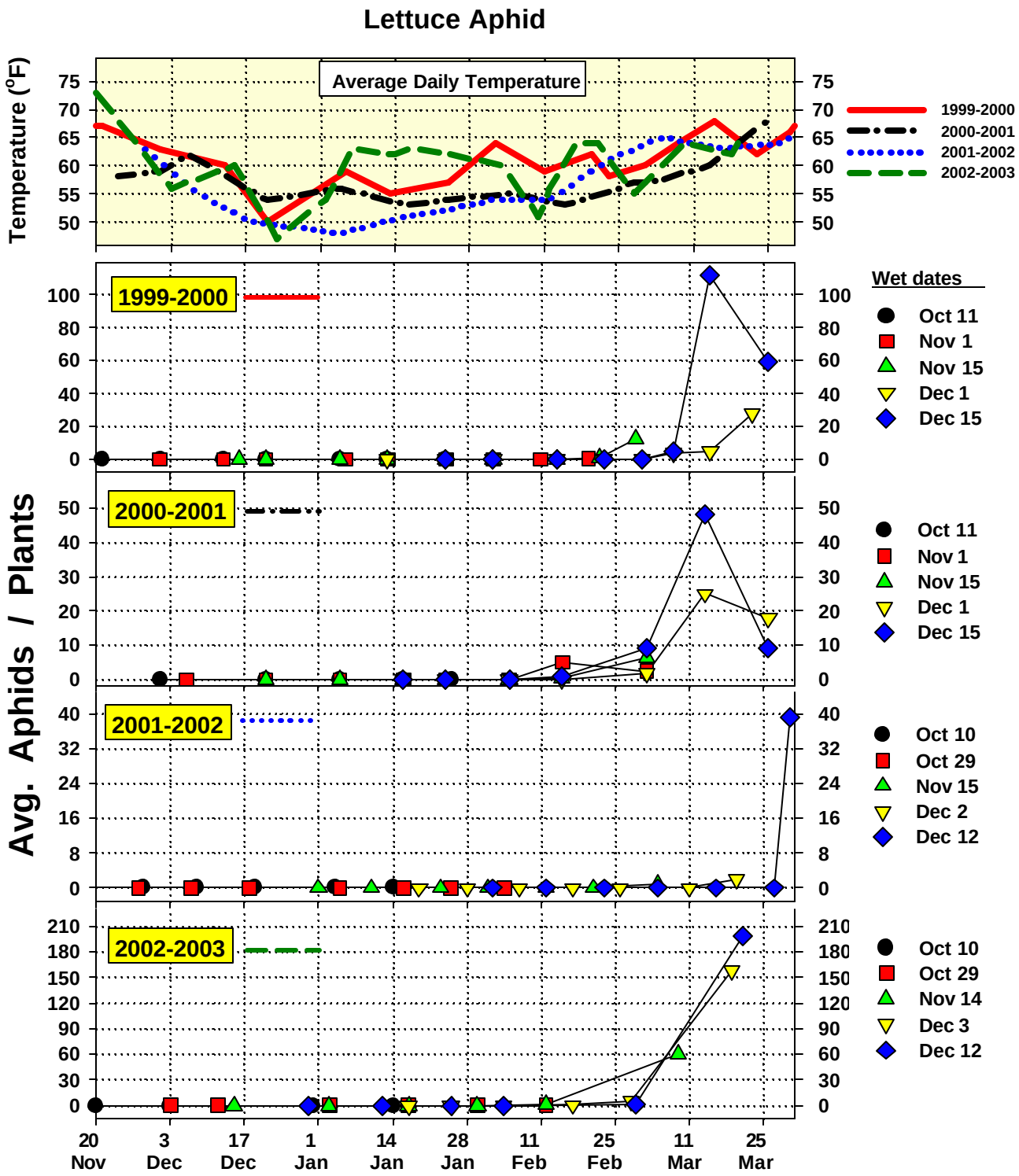


Figure 6. Average Lettuce Aphid densities on untreated head lettuce plots planted at intervals during the growing season, Yuma Agricultural Center, 1999-2003.

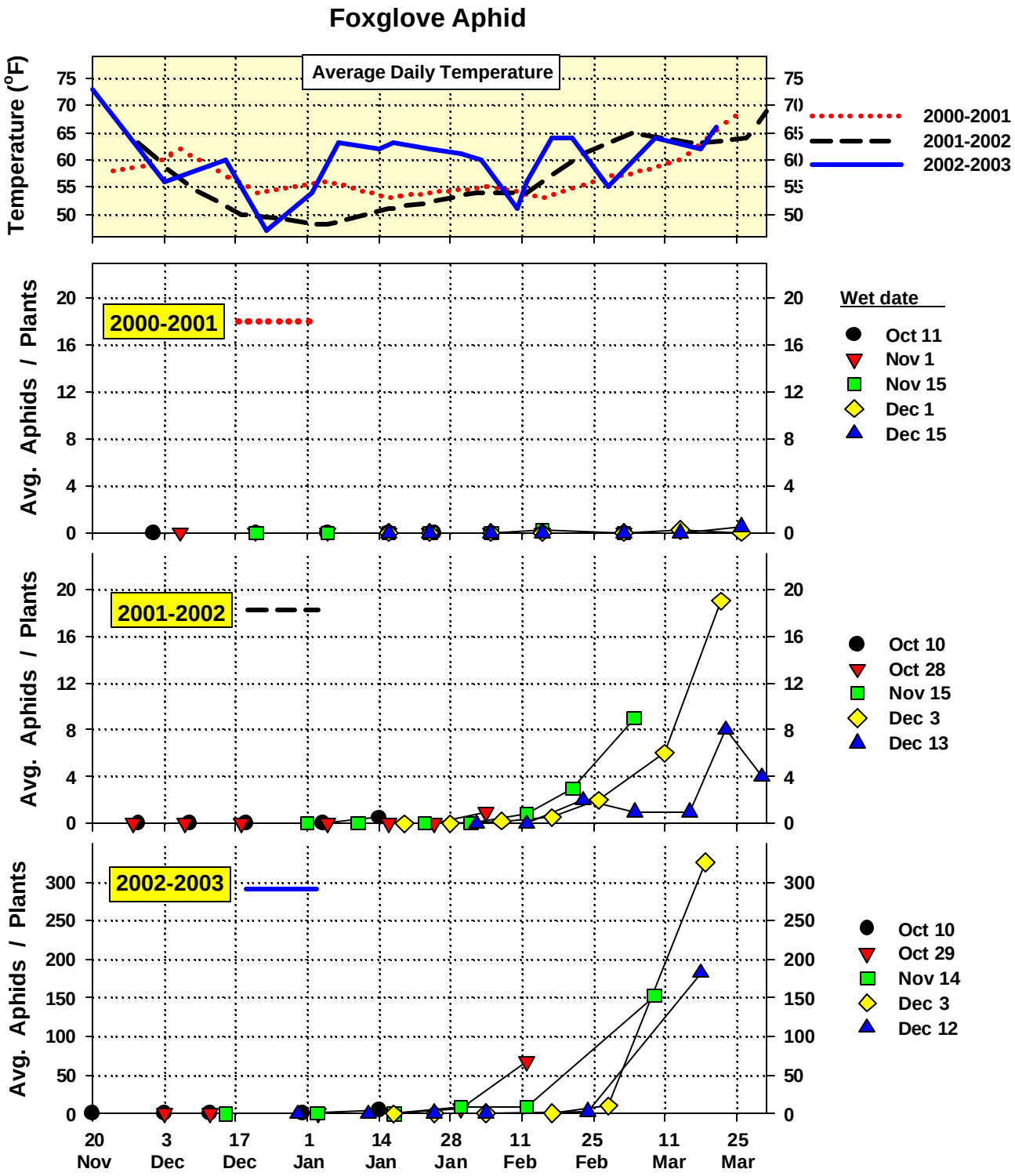


Figure 7. Average Foxglove Aphid densities on untreated head lettuce plots planted at intervals during the growing season, Yuma Agricultural Center, 1999-2003.

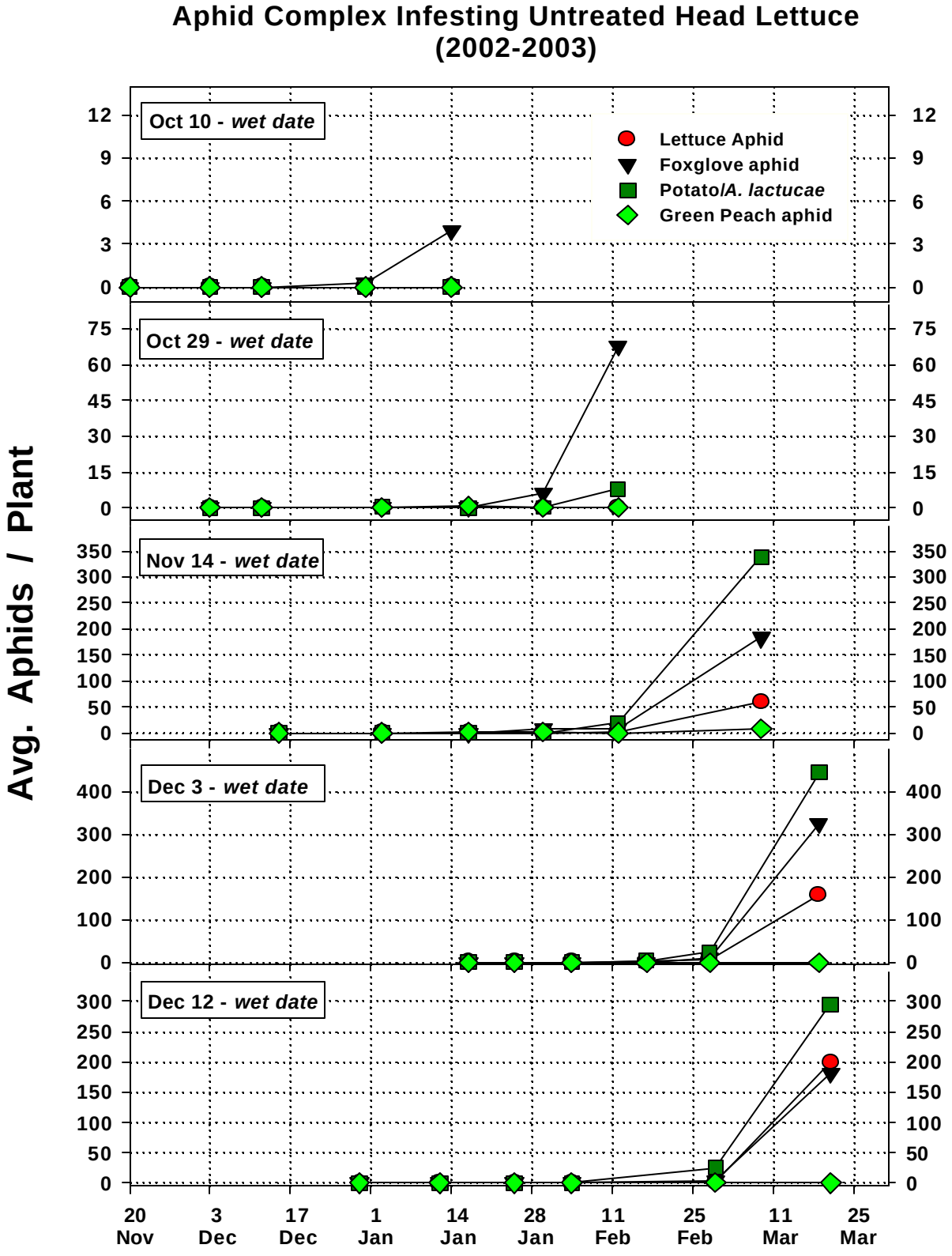


Figure 8. Relative comparison of aphid species infesting untreated head lettuce in plots planted at various intervals during the growing season, Yuma Agricultural Center, 2002-2003.

Table 4.

Growing Season	Planting date	Harvest date	Lettuce Variety	Temperature (ºF)			Rain (in.)	Mean Apterous Aphids / Plant at Harvest					
								Green Aphid Complex		Lettuce Aphid		Foxglove Aphid	
				Max	Min	Avg		Head	Frame	Head	Frame	Head	Frame
1999-2000	11-Oct	24-Jan	*Grizzley*	*81*	48	64	0	0	0	0	0	0	0
	1-Nov	20-Feb	*Wolverine*	*75*	45	58	0.1	0	0	0	0	0	0
	15-Nov	1-Mar	*Del Rio*	*75*	45	59	0.1	1.3	0.6	12.3	0	0	0
	1-Dec	23-Mar	*Jackel*	*73*	44	60	0.3	0.3	0.3	8.2	0.5	0	0
	15-Dec	23-Mar	*Diamond*	*74*	45	60	0.3	0.2	0.1	42.9	0.6	0	0
2000-2001	11-Oct	25-Jan	*Grizzley*	*74*	50	61	1.2	2	14.4	0	0	0	0
	1-Nov	2-Mar	*Wolverine*	*70*	45	57	1.16	15.2	38.5	5.1	0	0	0
	15-Nov	3-Mar	*Del Rio*	*70*	44	56	1.12	8.5	42.6	6.5	0.9	0	0
	1-Dec	26-Mar	*Jackel*	*72*	46	58	2.9	2.6	12.9	9.6	0.4	0	0
	15-Dec	26-Mar	*Diamond*	*73*	47	59	2.9	0.3	3.0	8.2	0.6	0	0
2001-2002	10-Oct	14-Jan	*Wolverine*	*78*	49	63	0.1	0	0	0	0	0	0
	28-Oct	4-Feb	*Grizzley*	*72*	44	58	0	0	2.3	0	0	0.3	0
	15-Nov	5-Mar	*Wolverine*	*74*	44	58	0	0.5	7.1	0	0	0	0.1
	3-Dec	22-Mar	*Diamond*	*72*	41	57	0	3.6	7.9	1.1	0.1	11.7	2.9
	13-Dec	6-Apr	*Diamond*	*73*	42	57	0	1.0	1.5	6.3	0.4	1.4	6.3
2002-2003	10-Oct	14-Jan	*Wolverine*	*77*	47	59	0.03	0.4	3.5	0	0	0.5	3.4
	29-Oct	12-Feb	*Grizzley*	*74*	45	59	1.27	1.1	6.9	0	0	2.4	48.1
	14-Nov	9-Mar	*Bubba*	*73*	45	59	1.27	96.6	244.6	44.7	16.4	33.9	120.9
	3-Dec	18-Mar	*Diamond*	*73*	44	58	1.23	105.5	345.6	145.7	21.4	125.9	201.3
	12-Dec	18-Mar	*Diamond*	*74*	45	59	1.23	126.2	170.9	182.2	18.9	81.8	101.0

Objective 3. **To evaluate new insecticides and other adjuvants which might enhance the performance of new active ingredients for season-long control of the Aphids and Thrips.**

Trial 1. Comparison of Neonicotinoid Insecticides For Aphid & Thrips Control in Head Lettuce

Tests Location: Yuma Agricultural Center, Yuma, Arizona

Crop: Head lettuce, *Lactuca sativa* L. 'Bubba'

Planting date: Nov 14, 2003

Irrigation: Sprinkler irrigation at stand establishment; furrow irrigated thereafter

Experimental design: Four beds wide by 50 ft long (two seed lines/ beds; 42 " centers); bordered by two untreated beds. Four replications of each treatment in a randomized complete block design.

Treatments:

Treatments	Rate/ac
1. Admire -at plant	16 oz
2. Platinum -at plant	8 oz
3. Platinum (2^{nd} sidedress)	8 oz
4. Dinotefuron 20 G (2^{nd} sidedress)	500 g ai/ac
5. Dinotefuron 20G (foliar)	120 g ai/ac
6. Assail	1.7 oz
7. Assail+Capture	1.7+5 oz
8. Actara	4.0 oz
9. Actara+Capture	4.0 +5 oz
10. Fulfill	2.75 oz
11. Fulfill+Capture	2.75 + 5 oz
12. Flonicamid	0.133 lb ai
13. Untreated	--

Application Procedures: Foliar applications were made with a CO_2 operated boom sprayer operated at 60 psi and 27 GPA. A directed spray (nozzles directed toward the plants) was delivered through 3 nozzles (TX-10) per bed. A total of 3 spray applications were applied on Jan 21, Feb 4 and 16. The first spray was initiated at early aphid colonization - 0.7 apterous aphids /plant (0.3 PA/AL, 0.2 FG, and 0.2 GPA aphids/plant; 20 % of the plants were infested with at least 1 aphid). An adjuvant was applied to all foliar treatments; DyneAmic on Spray #1 and Exit on spray # 2 and 3 at 0.125%v/v. The at-planting soil applications of Admire and Platinum were applied as a preplant injection at a depth of 1.5" below the seed line at bed shaping in 15 GPA final dilution. The side dress treatments were applied at 2^{nd} side dress (Jan 15) similar to fertilizer side dressing and the materials were placed on the bed shoulder at @ 3" below the soil in 30 GPA final dilution similar to N applications.

Evaluation Procedures: Aphid populations were assessed by estimating the number of aphids /plant in whole plant, destructive samples. Four aphid species were present on plants during the test; Foxglove aphid (FG), Potato aphid (PA), *Acyrthosiphon lactucae* (AL), Lettuce aphid (LA) and Green peach aphid (GPA). On each sampling date, 10 plants were randomly selected from each plot and placed individually into large 3-gal tubs. Each plant was sampled by visually examining all plant foliage and counting the number of alate and apterous aphids present. At harvest, infestation levels of apterous aphids were estimated by randomly selecting 10 plants within each replicate, visually counting the number of aphids on frame/wrapper leaves and heads.

Thrips control was based on the number of live adults and nymphs per plant sampled from the center 2 rows of each replicate at intervals following each application. Numbers of thrips adults and larvae from 3 plants per replicate were recorded on each sample. Samples were taken by removing plants and beating them vigorously against a screened pan for a predetermined duration. Inside of the pan was a sticky trap to catch the dislodged thrips. Sticky traps were then taken to the laboratory where adult and larvae were counted. Data was analyzed using ANOVA and mean differences were estimated using a protected $LSD_{(0.05)}$ or a paired t $test_{(p<0.05)}$.

Aphid Efficacy I – pre heading **Feb 3 (14 DAT 1)**

		Apterous aphids (mean / plant)				
Treatment	**Timing**	**FG**	**PA/AL**	**GPA**	**LA**	**Total**
Admire	Soil- At plant	9.7 a	0 b	0 a	0 a	9.7 b
Platinum	Soil- At plant	6.3 a	0.2 b	0 a	0 a	6.5 b
Platinum	Soil -2nd sidedress	6.8 a	3.1 b	0.2 a	0 a	10.0 b
dinotefuron	Soil -2nd sidedress	3.3 a	4.8 b	0.4 a	0 a	8.5 b
dinotefuron	Foliar-1/21, 2/4, 2/16	2.5 a	3.2 b	0.1 a	0.5 a	6.2 b
Assail	Foliar-1/21, 2/4, 2/16	13.5 a	2.9 b	0.1 a	0 a	16.4 b
Assial+Capture	Foliar-1/21, 2/4, 2/16	1.4 a	0.1 b	0 a	0 a	1.5 b
Actara	Foliar-1/21, 2/4, 2/16	7.1 a	0.1 b	0.1 a	0 a	7.3 b
Actara+Capture	Foliar-1/21, 2/4, 2/16	5.3 a	0.3 b	0.2 a	0 a	5.7 b
Fulfill	Foliar-1/21, 2/4, 2/16	1.9 a	2.9 b	0.1 a	0 a	4.9 b
Fulfill+Capture	Foliar-1/21, 2/4, 2/16	1.8 a	0.1 b	0.1 a	0 a	2.0 b
Flonicamid	Foliar-1/21, 2/4, 2/16	0.6 a	1.8 b	0.2 a	0 a	2.7 b
Untreated	none	11.0 a	34.9 a	0.1 a	0 a	46.1 a

		Infested Plants (%)				
Treatment	**Timing**	**FG**	**PA/AL**	**GPA**	**LA**	**Total**
Admire	Soil- At plant	53 a	3 c	0 c	0 a	60 a-d
Platinum	Soil- At plant	43 a	7 c	0 c	0 a	50 b-d
Platinum	Soil -2nd sidedress	57 a	17 bc	7 bc	0 a	73 a-c
dinotefuron	Soil -2nd sidedress	50 a	60 a	27 a	0 a	93 a
dinotefuron	Foliar-1/21, 2/4, 2/16	50 a	17 bc	3 bc	3 a	63 a-d
Assail	Foliar-1/21, 2/4, 2/16	57 a	7 c	7 bc	0 a	63 a-d
Assial+Capture	Foliar-1/21, 2/4, 2/16	33 a	3 c	0 c	0 a	33 d
Actara	Foliar-1/21, 2/4, 2/16	60 a	3 c	7 bc	0 a	60 a-d
Actara+Capture	Foliar-1/21, 2/4, 2/16	37 a	7 c	3 bc	0 a	30 d
Fulfill	Foliar-1/21, 2/4, 2/16	37 a	37 ab	7 bc	0 a	60 a-d
Fulfill+Capture	Foliar-1/21, 2/4, 2/16	33 a	7 c	17 ab	0 a	43 cd
Flonicamid	Foliar-1/21, 2/4, 2/16	23 a	13 bc	7 bc	0 a	40 cd
Untreated	none	67 a	47 a	3 bc	0 a	87 ab

Mean followed by the same letter are not significantly different ($LSD_{p<0.05}$)

Aphid Efficacy **Mar 6 - Harvest Evaluation**

		Foxglove Aphid (mean / plant)					
Aphid		**Winged forms**			**Colonizing forms**		
Treatment	**Timing**	**Wrappers**	**Heads**	**Total**	**Wrappers**	**Heads**	**Total**
Admire	Soil- At plant	0.3 a	0.1 a	0.4 a	43.6 bc	8.0 cd	51.7 bc
Platinum	Soil- At plant	0.7 a	0.1 a	0.8 a	39.4 bc	22.6 bc	62.0 bc
Platinum	Soil -2nd sidedress	0.6 a	0.2 a	0.8 a	64.4 b	16.9 bc	81.2 bc
dinotefuron	Soil -2nd sidedress	0.3 a	0 a	0.3 a	82.3 b	28.5 ab	110.8 b
dinotefuron	Foliar-1/21, 2/4, 2/16	0.7 a	0.2 a	0.9 a	52.8 b	28.4 ab	81.2 bc
Assail	Foliar-1/21, 2/4, 2/16	0.5 a	0.4 a	0.9 a	18.0 cd	14.8 bc	32.9 c
Assial+Capture	Foliar-1/21, 2/ 4, 2/16	0.5 a	0.2 a	0.7 a	3.7 de	3.4 de	7.1 d
Actara	Foliar-1/21, 2/4, 2/16	1.3 a	0.1 a	1.4 a	2.2 e	0.9 e	3.1 d
Actara+Capture	Foliar-1/21, 2/4, 2/16	0.3 a	0.2 a	0.5 a	1.1 e	1.2 e	2.3 d
Fulfill	Foliar-1/21, 2/4, 2/16	0.1 a	0.3 a	0.4 a	1.5 e	1.4 e	2.9 d
Fulfill+Capture	Foliar-1/21, 2/4, 2/16	0.3 a	0.4 a	0.7 a	2.2 e	1.6 e	3.8 d
Flonicamid	Foliar-1/21, 2/4, 2/16	0.3 a	0.2 a	0.5 a	2.7e	2.0 e	4.7 d
Untreated	none	3.9 a	1.4 a	5.3 a	233.9 a	70.4 a	303.3 a

		Potato Aphid/ *A. lactucae* (mean / plant)					
Aphid		**Winged forms**			**Colonizing forms**		
Treatment	**Timing**	**Wrappers**	**Heads**	**Total**	**Wrappers**	**Heads**	**Total**
Admire	Soil- At plant	0 a	0 a	0 a	0.3 bc	0.6 c	0.9 bcd
Platinum	Soil- At plant	0 a	0 a	0 a	1.0 bc	0 c	1.0 bcd
Platinum	Soil -2nd sidedress	0 a	0 a	0 a	7.1 b	1.2 bc	8.3 b
dinotefuron	Soil -2nd sidedress	0.1 a	0 a	0.1 a	117.7 a	22.0 a	139.7 a
dinotefuron	Foliar-1/21, 2/4, 2/16	0 a	0.1 a	0.1 a	44.1 a	8.6 b	52.7 a
Assail	Foliar-1/21, 2/4, 2/16	0.2 a	0.1 a	0.3 a	3.2 bc	1.3 c	4.6 bcd
Assial+Capture	Foliar-1/21, 2/4, 2/16	0.1 a	0 a	0.1 a	1.0 bc	0 c	1.0 bcd
Actara	Foliar-1/21, 2/4, 2/16	0.1 a	0 a	0.1 a	0 c	0 c	0 d
Actara+Capture	Foliar-1/21, 2/4, 2/16	0 a	0 a	0 a	0.4 bc	0.5 c	1.0 bcd
Fulfill	Foliar-1/21, 2/4, 2/16	0.1 a	0.1 a	0.2 a	1.6 bc	2.8 bc	4.4 bcd
Fulfill+Capture	Foliar-1/21, 2/4, 2/16	0 a	0 a	0 a	0.2 bc	0 c	0.2 cd
Flonicamid	Foliar-1/21, 2/4, 2/16	0 a	0 a	0 a	0 c	0.2 c	0.2 cd
Untreated	none	0.3 a	0.1 a	0.4 a	194.8 a	39.1 a	233.9 a

Mean followed by the same letter are not significantly different ($LSD_{p<0.05}$)

Aphid Efficacy **Mar 6 - Harvest Evaluation**

		Lettuce Aphid (mean / plant)					
Aphid		**Winged forms**			**Colonizing forms**		
Treatment	**Timing**	**Wrappers**	**Heads**	**Total**	**Wrappers**	**Heads**	**Total**
Admire	Soil- At plant	0 a	0 a	0 a	0 b	0.9 b	0.9 b
Platinum	Soil- At plant	0 a	0 a	0 a	0 b	0 b	0 b
Platinum	Soil -2nd sidedress	0 a	0 a	0 a	0 b	0.8 b	0.8 b
dinotefuron	Soil -2nd sidedress	0 a	0 a	0 a	0.1 b	1.6 b	1.7 b
dinotefuron	Foliar-1/21, 2/4, 2/16	0 a	0 a	0 a	0 b	0.4 b	0.4 b
Assail	Foliar-1/21, 2/4, 2/16	0 a	0 a	0 a	0 b	0 b	0 b
Assial+Capture	Foliar-1/21, 2/4, 2/16	0 a	0 a	0 a	0 b	0 b	0 b
Actara	Foliar-1/21, 2/4, 2/16	0 a	0 a	0 a	0 b	0 b	0 b
Actara+Capture	Foliar-1/21, 2/4, 2/16	0 a	0 a	0 a	0 b	0 b	0 b
Fulfill	Foliar-1/21, 2/4, 2/16	0 a	0 a	0 a	0 b	1.7 b	1.7 b
Fulfill+Capture	Foliar-1/21, 2/4, 2/16	0 a	0 a	0 a	0 b	0 b	0 b
Flonicamid	Foliar-1/21, 2/4, 2/16	0 a	0 a	0 a	0 b	0 b	0 b
Untreated	none	0 a	0.2 a	0.2 a	1.3 a	21.3 a	22.6 a

		Green Peach Aphid (mean / plant)					
Aphid		**Winged forms**			**Colonizing forms**		
Treatment	**Timing**	**Wrappers**	**Heads**	**Total**	**Wrappers**	**Heads**	**Total**
Admire	Soil- At plant	0 a	0 a	0 a	0 a	0 a	0 a
Platinum	Soil- At plant	0 a	0 a	0 a	0.2 a	0 a	0.2 a
Platinum	Soil -2nd sidedress	0 a	0 a	0 a	0 a	0 a	0 a
dinotefuron	Soil -2nd sidedress	0 a	0 a	0 a	0 a	0 a	0 a
dinotefuron	Foliar-1/21, 2/4, 2/16	0 a	0 a	0 a	0 a	0 a	0 a
Assail	Foliar-1/21, 2/4, 2/16	0.1 a	0 a	0.1 a	0.2 a	0 a	0.2 a
Assial+Capture	Foliar-1/21, 2/4, 2/16	0.1 a	0 a	0.1 a	0 a	0 a	0 a
Actara	Foliar-1/21, 2/4, 2/16	0 a	0 a	0 a	0 a	0 a	0 a
Actara+Capture	Foliar-1/21, 2/4, 2/16	0 a	0 a	0 a	0 a	0 a	0 a
Fulfill	Foliar-1/21, 2/4, 2/16	0 a	0 a	0 a	0.5 a	0.3 a	0.8 a
Fulfill+Capture	Foliar-1/21, 2/4, 2/16	0.1 a	0 a	0.1 a	0.2 a	0.1 a	0.3 a
Flonicamid	Foliar-1/21, 2/4, 2/16	0 a	0 a	0 a	0 a	0 a	0 a
Untreated	none	0 a	0 a	0 a	0.2 a	0.2 a	0.4 a

Mean followed by the same letter are not significantly different ($LSD_{p<0.05}$)

Aphid Efficacy **Mar 6 - Harvest Evaluation**

		Total Aphids (mean / plant)					
Aphid		**Winged forms**			**Colonizing forms**		
Treatment	**Timing**	**Wrappers**	**Heads**	**Total**	**Wrappers**	**Heads**	**Total**
Admire	Soil- At plant	0.4 a	0.1a	0.5 a	44.0 cd	9.5 de	53.5 d
Platinum	Soil- At plant	0.8 a	0.1 a	0.9 a	40.7 d	22.6 cd	63.3 cd
Platinum	Soil -2nd sidedress	0.7 a	0.2 a	0.9 a	71.5 bcd	18.9 cd	90.4 cd
dinotefuron	Soil -2nd sidedress	0.4 a	0 a	0.4 a	200.1 ab	52.0 ab	252.1 ab
dinotefuron	Foliar-1/21, 2/4, 2/16	0.8 a	0.3 a	1.1 a	96.9 bc	37.4 bc	134.3 bc
Assail	Foliar-1/21, 2/4, 2/16	0.8 a	0.5 a	1.3 a	21.5 de	16.2 cd	37.7 d
Assial+Capture	Foliar-1/21, 2/4, 2/16	0.7 a	0.3 a	1.0 a	4.8 ef	3.4 ef	8.2 e
Actara	Foliar-1/21, 2/4, 2/16	1.5 a	0.1 a	1.6 a	2.2 f	0.9 f	3.1 e
Actara+Capture	Foliar-1/21, 2/4, 2/16	0.3 a	0.3 a	0.6 a	1.6 f	1.8 f	3.3 e
Fulfill	Foliar-1/21, 2/4, 2/16	0.3 a	0.4 a	0.7 a	3.6 f	6.1 def	9.8 e
Fulfill+Capture	Foliar-1/21, 2/4, 2/16	0.5 a	0.5 a	1.0 a	2.6 f	1.7 f	4.3 e
Flonicamid	Foliar-1/21, 2/4, 2/16	0.4 a	0.3 a	0.7 a	2.7 f	2.3 f	5.0 e
Untreated	none	4.2 a	1.8a	6.0 a	430.2 a	130 a	560.3 a

Mean followed by the same letter are not significantly different ($LSD_{p<0.05}$)

Thrips Efficac y

		Mean thrips/ plant (% reduction compared with the untreated check)					
Aphid		**Jan 27 (6 DAT 1)**			**Feb 23 (7 DAT 3)**		
Treatment	**Timing**	**Adult**	**Larvae**	**Total**	**Adult**	**Larvae**	**Total**
Admire	Soil- At plant	20.1 a (0)	46.6 a-c (15)	66.7 ab (5)	-	-	-
Platinum	Soil- At plant	-	-	-	-	-	-
Platinum	Soil -2nd sidedress	-	-	-	-	-	-
dinotefuron	Soil -2nd sidedress	-	-	-	-	-	-
dinotefuron	Foliar-1/21, 2/4, 2/16	11.4 bc (32)	28.0 cd (48)	39.4 cde (44)	37.6 a (0)	54.4 b (47)	92.0 c (39)
Assail	Foliar-1/21, 2/4, 2/16	10.3 bc (39)	38.1 a-d (30)	48.4 a-e (31)	33.3 ab (3)	53.7 bc (53)	87.0 c (42)
Assial+Capture	Foliar-1/21, 2/4, 2/16	7.6 c (55)	19.6 d (63)	27.1 e (61)	24.0 bc (30)	26.7 bc (77)	50.7 de (66)
Actara	Foliar-1/21, 2/4, 2/16	12.0 bc (29)	29.0 b-d (46)	41.0 b-e (41)	28.7 abc (15)	50.3 bc (57)	79.0 cd (47)
Actara+Capture	Foliar-1/21, 2/4, 2/16	6.0 c (65)	32.6 a-d (41)	38.6 c-e (46)	19.4 c (45)	26.0 c (78)	45.4 e (70)
Fulfill	Foliar-1/21, 2/4, 2/16	8.4 c (50)	55.7 a (0)	64.1 a-c (9)	37.0 a (0)	145.4 a (0)	182.4 a (0)
Fulfill+Capture	Foliar-1/21, 2/4, 2/16	1.4 bc (38)	44.1 a-d (19)	54.6 a-d (21)	23.9 bc(30)	41.2 bc (65)	65.1 cde (57)
Flonicamid	Foliar-1/21, 2/4, 2/16	10.1 bc (40)	26.2 cd (52)	36.3 de (49)	30.9 abc (10)	60.9 b (47)	91.8 c (39)
Untreated	none	16.8 ab	53.7 ab	70.4 a	34.1 ab	116.4 a	150.6 b

Trial 2. Efficacy of Aphids and Thrips in Head Lettuce II -2003

Tests Location: Yuma Agricultural Center, Yuma, Arizona

Crop: Lettuce, *Lactuca sativa* L. ' Desert Spring'

Planting /wet Date: Dec 3, 2002

Irrigation: Sprinkler irrigation at stand establishment; furrow irrigated thereafter

Experimental design: Two beds wide by 50 ft long (two seed lines/ beds; 42 " centers); bordered by two untreated beds. Four replications of each treatment in a randomized complete block design.

Treatments:

Treatments	Rate/ac
1. Success	6 oz
2. Success	9.5 oz
3. Success+Mustang	5 oz + 4 oz
4. MSR+Capture	2 pt + 5 oz
5. Provado/Endosulfan	3.75 oz +1 qt
6 Orthene+Mustang	1 lb + 4 oz
7. Lannate+Mustang	0.75 lb + 4 oz
8. Dimethoate	12 oz
9. Endosulfan	1.33 qt
10. Untreated	--

Application Procedures: Foliar applications were made with a CO_2 operated boom sprayer operated at 60 psi and 27 GPA. A directed spray (nozzles directed toward the plants) was delivered through 3 nozzles (TX-10) per bed. The first spray was initiated at early aphid colonization - 1.4 apteous aphids /plant(1.3 PA, 0.04 FG, and 0.06 GPA aphids / plant; 16 % of the plants were infested with at least 1 aphid). A total of 3 spray applications were applied on Jan 26, Feb 8 and 18. An adjuvant was applied to all foliar treatments; DyneAmic at 0.125%v/v.

Evaluation Procedures: Aphid populations were assessed by estimating the number of aphids /plant in whole plant, destructive samples. Four aphid species were present on plants during the test; Foxglove aphid (FG), Potato aphid (PA), *Acyrthosiphon lactucae* (AL), Lettuce aphid (LA) and Green peach aphid (GPA). On each sampling date, 10 plants were randomly selected from each plot and placed individually into large 3-gal tubs. Each plant was sampled by visually examining all plant foliage and counting the number of alate and apterous aphids present. At harvest, infestation levels of apterous aphids were estimated by randomly selecting 10 plants within each replicate, visually counting the number of aphids on frame/wrapper leaves and heads separately.

Western flower thrips control was based on the number of live adults and nymphs per plant sampled from the center of each replicate at intervals following each application. Numbers of thrips adults and larvae from 3 plants per replicate were recorded on each sample. Samples were taken by removing plants and beating them vigorously against a screened pan for a predetermined duration. Inside of the pan was a sticky trap to catch the dislodged thrips. Sticky traps were then taken to the laboratory where adult and larvae were counted. Data was analyzed using ANOVA and mean differences were estimated using a protected $LSD_{(0.05)}$.

Aphid Efficacy – pre heading

Feb 5 (10 DAT 2)

		Apterous aphids (mean / plant)				
Treatment	**Rate/ac**	**FG**	**PA/AL**	**GPA**	**LA**	**Total**
Success	6 oz	0	0.1	0	0	0.1
Success	9.5 oz	0	1.2	0	0	1.2
Success+Mustang	5 oz+ 4 oz	0	1.2	0	0	1.2
MSR+Capture	2 pt + 5 oz	0	0	0	0	0
Provado+Endosulfan	3.7 oz+ 1 qt	0	0.7	0	0	0.7
Orthene+Mustang	1 lb + 4 oz	0	0	0	0	0
Lannate+Mustang	0.75 lb +4 oz	0	0.1	0.1	0	0.2
Dimethoate	12 oz	0	0.4	0.2	0	0.6
Endosulfan	1.33 qt	0	1.2	0	0	1.2
Untreated	-	0.2	14.4	0.2	0	14.8

* no significant differences among treatments

Aphid Efficacy – early heading

Feb 25 (7 DAT 3)

		Apterous aphids (mean / plant)				
Treatment	**Timing**	**FG**	**PA/AL**	**GPA**	**LA**	**Total**
Success	6 oz	34.3 a	65.3 b	0.4 a	0 a	100.0 b
Success	9.5 oz	-	-	-	-	-
Success+Mustang	5 oz+ 4 oz	-	-	-	-	-
MSR+Capture	2 pt + 5 oz	0.7 bc	0.1d	0.5 a	0 a	1.3 d
Provado+Endosulfan	3.7 oz+ 1 qt	0.8 bc	0.3 d	0.2 a	0 a	1.3 d
Orthene+Mustang	1 lb + 4 oz	0.3 c	0.1 d	0.5 a	0 a	0.9 d
Lannate+Mustang	0.75 lb +4 oz	7.4 ab	11.2 bc	0.8 a	0 a	19.4 bc
Dimethoate	12 oz	1.5 bc	0.2 d	1.2 a	0.3 a	3.2 cd
Endosulfan	1.33 qt	0.8 bc	0.5 cd	1.0 a	0.1 a	2.4 cd
Untreated	-	19.0 ab	482.1 a	1.8 a	0.4 a	503.3 a

Mean followed by the same letter are not significantly different ($LSD_{p<0.05}$)

Aphid Efficacy **Mar 12** **Harvest Evaluation**

		Foxglove Aphid (mean / plant)					
		Winged forms			Colonizing forms		
Treatment	**Rate**	**Frame**	**Heads**	**Total**	**Frame**	**Heads**	**Total**
Success	6.0 oz	1.6 b	0.1 a	1.7 ab	209.6 ab	37.5 ab	247.1 ab
Success	10. oz	0.7 bcd	0.4 a	1.1 bc	243.9 ab	22.0 abc	265.9 ab
Success +Mustang	5 oz+ 4 oz	4.4 a	0.1 a	4.5 a	448.9 a	46.4 a	494.9 a
MSR + Capture	2 pts + 5 oz	0.4 cd	0 a	0.4 c	7.7 d	0.4 e	8.1 e
Provado + Endosulfan	3.75 oz+32 oz	0.2 d	0.2 a	0.4 c	9.0 d	3.5 cde	12.5 e
Orthene+Mustang	1 lb + 4.0 oz	0.6 bcd	0.1 a	0.7 bc	10.4 d	2.2 de	12.6 e
Lannate+Mustang	0.75 lb+4.0 oz	1.2 bc	0 a	1.2 bc	121.4 ab	4.9 cd	126.3 bc
Dimethoate	0.75 pt	0.9 bcd	0.2 a	1.1 bc	13.0 cd	2.6 de	15.6 e
Endosulfan	1.0 qt	0.5 bcd	0.1 a	0.6 bc	22.2 cd	4.2 cde	26.4 de
Untreated		0.4 bcd	0 a	0.4 c	98.5 bc	8.3 bcd	106.7 cd

Mean followed by the same letter are not significantly different (LSD $_{p<0.05}$)

		Potato Aphid / *A. lactucae* (mean / plant)					
		Winged forms			Colonizing forms		
Treatment	**Rate**	**Frame**	**Heads**	**Total**	**Frame**	**Heads**	**Total**
Success	6.0 oz	1.5 b	0.3 b	1.8 b	368.1 ab	49.2 bc	417.3 ab
Success	10. oz	5.5 ab	0.4 b	5.9 ab	776.7 a	63.9 ab	840.5 a
Success +Mustang	5 oz+ 4 oz	3.7 ab	0.1 cd	3.8 ab	633.7 a	67.9 ab	701.7 a
MSR + Capture	2 pts + 5 oz	0.7 b	0.5 b	1.2 b	6.7 d	2.5 d	9.3 d
Provado + Endosulfan	3.75 oz+32 oz	0.9 b	0.5 b	1.4 b	20.6 cd	5.8 cd	26.4 cd
Orthene+Mustang	1 lb + 4.0 oz	1.4 b	0 d	1.4 b	23.8 cd	0.9 d	24.7 cd
Lannate+Mustang	0.75 lb+4.0 oz	1.5 b	0.5 b	2.0 b	305.7 b	9.7 cd	315.4 b
Dimethoate	0.75 pt	2.1 b	0.5 b	2.6 b	15.9 cd	2.3 d	18.2 cd
Endosulfan	1.0 qt	0.6 b	0.3 bc	0.9 b	35.3 c	4.5 cd	39.8 c
Untreated		11.1 a	1.0 a	12.1 a	1034.5 a	138.9 a	1173.3 a

Mean followed by the same letter are not significantly different (LSD $_{p<0.05}$)

Aphid Efficacy II **Mar 12** **Harvest Evaluation**

		Lettuce Aphid (mean / plant)					
		Winged forms			Colonizing forms		
Treatment	**Rate**	**Frame**	**Heads**	**Total**	**Frame**	**Heads**	**Total**
Success	6.0 oz	0	0	0	0.2	1.2	1.4
Success	10. oz	0	0	0	0	0	0
Success +Mustang	5 oz+ 4 oz	0	0.1	0.1	0	0.1	0.1
MSR + Capture	2 pts + 5 oz	0	0	0	0.1	0.1	0.1
Provado + Endosulfan	3.75 oz+32 oz	0	0	0	0.1	0.9	1.0
Orthene+Mustang	1 lb + 4.0 oz	0	0	0	0	0.3	0.3
Lannate+Mustang	0.75 lb+4.0 oz	0	0	0	0	0.3	0.3
Dimethoate	0.75 pt	0	0	0	0.5	0.6	1.1
Endosulfan	1.0 qt	0	0	0	0	0.7	0.7
Untreated		0	0	0	0	4.1	4.1

* no significant differences among treatments

		Green Peach Aphid (mean / plant)					
		Winged forms			Colonizing forms		
Treatment	**Rate**	**Frame**	**Heads**	**Total**	**Frame**	**Heads**	**Total**
Success	6.0 oz	0.1	0.1	0.2	0	0	0
Success	10. oz	0	0	0	0.3	0	0.3
Success +Mustang	5 oz+ 4 oz	0	0	0	0	0	0
MSR + Capture	2 pts + 5 oz	0.1	0.1	0.2	0.7	0.9	1.6
Provado + Endosulfan	3.75 oz+32 oz	0.1	0	0.1	0.1	0	0.1
Orthene+Mustang	1 lb + 4.0 oz	0.1	0	0.1	0.3	0	0.3
Lannate+Mustang	0.75 lb+4.0 oz	0.2	0.1	0.3	1.3	0.1	1.4
Dimethoate	0.75 pt	0.1	0	0.1	0.6	0.2	0.8
Endosulfan	1.0 qt	0.1	0	0.1	0.7	0	0.7
Untreated		0.1	0	0.1	0	0	0

* no significant differences among treatments

Aphid Efficacy II **Mar 12** **Harvest Evaluation**

Aphid Treatment	Rate	Total Aphids (mean / plant)					
		Winged forms			Colonizing forms		
		Wrappers	Heads	Total	Wrappers	Heads	Total
Success	6.0 oz	3.2 ab	0.5 ab	3.7 bcd	577.9 ab	87.9 a	665.8 ab
Success	10. oz	6.2 ab	0.8 ab	7.0 abc	1020.9 a	85.9 a	1106.8 a
Success +Mustang	5 oz+ 4 oz	8.1 a	0.3 bc	8.4 ab	1082.3 a	114.5 a	1196.7 a
MSR + Capture	2 pts + 5 oz	1.1 b	0.7 ab	1.8 d	15.2 d	4.0 d	19.2 d
Provado + Endosulfan	3.75 oz+32 oz	1.2 b	0.7 ab	1.9 d	29.7 cd	10.1 bc	39.9 cd
Orthene+Mustang	1 lb + 4.0 oz	2.1 b	0.1 c	2.2 cd	34.5 cd	3.3 d	37.8 cd
Lannate+Mustang	0.75 lb+4.0 oz	2.9 ab	0.5 abc	3.4 bcd	428.3 b	15.0 b	443.3 b
Dimethoate	0.75 pt	3.1 ab	0.7 ab	3.8 bcd	29.9 cd	5.7 cd	35.7 cd
Endosulfan	1.0 qt	1.3 b	0.4 bc	1.7 d	58.3 c	9.4 bc	67.7 c
Untreated		11.5 a	1.0 a	12.5 a	1132.9 a	151.4 a	1284.1 a

Mean followed by the same letter are not significantly different (LSD $_{p<0.05}$)

Thrips Efficacy

Jan 31 (5 DAT1)

		Mean Thrips / Plant		
Treatment	**Rate/ac**	**Adults**	**Larvae**	**Total**
Success	6 oz	6.6 b	16.4 c	23.0 cd
Success	9.5 oz	3.6 cd	22.7 bc	26.2 bcd
Success+Mustang	5 oz+ 4 oz	2.8 cd	37.9 ab	40.7 abc
MSR+Capture	2 pt + 5 oz	2.3 cd	29.4 abc	31.8 bcd
Provado+Endosulfan	3.7 oz+ 1 qt	4.9 bc	42.0 ab	46.9 ab
Orthene+Mustang	1 lb + 4 oz	1.2 d	29.4 abc	30.6 bcd
Lannate+Mustang	0.75 lb +4 oz	1.0 d	14.0 c	15.0 d
Dimethoate	12 oz	2.8 cd	24.1 bc	26.9 bcd
Endosulfan	1.33 qt	2.6 cd	32.0 abc	34.3 bcd
Untreated	-	11.7 a	47.2 a	58.9 a

Mean followed by the same letter are not significantly different ($LSD_{p<0.05}$)
Pre-spray means = 20.0 adults/plant and 23.8 larvae / plant

Feb 7 (12 DAT 1)

		Mean Thrips / Plant		
Treatment	**Rate/ac**	**Adults**	**Larvae**	**Total**
Success	6 oz	24.2 abc	24.1 b	48.3 b
Success	9.5 oz	20.6 bcd	24.0 b	44.6 b
Success+Mustang	5 oz+ 4 oz	19.6 bcd	30.2 b	49.8 b
MSR+Capture	2 pt + 5 oz	16.4 cd	40.1 ab	56.5 ab
Provado+Endosulfan	3.7 oz+ 1 qt	30.2 a	49.6 a	79.8 a
Orthene+Mustang	1 lb + 4 oz	13.1 d	23.1 b	36.2 b
Lannate+Mustang	0.75 lb +4 oz	12.9 d	22.8 b	26.7 b
Dimethoate	12 oz	21.6 abcd	34.9 ab	56.3 ab
Endosulfan	1.33 qt	21.4 abcd	21.8 b	43.2 b
Untreated	-	26.9 ab	49.2 a	76.1 a

Mean followed by the same letter are not significantly different ($LSD_{p<0.05}$)

Feb 17 (10 DAT 2)

		Mean Thrips / Plant		
Treatment	**Rate/ac**	**Adults**	**Larvae**	**Total**
Success	6 oz	21.7 a	11.4 cd	33.1 cde
Success	9.5 oz	18.2 ab	14.4 cd	32.7 cde
Success+Mustang	5 oz+ 4 oz	14.6 bc	11.8 cd	26.3 def
MSR+Capture	2 pt + 5 oz	22.2 a	17.6 c	39.8 bc
Provado+Endosulfan	3.7 oz+ 1 qt	19.1 ab	27.8 b	46.9 b
Orthene+Mustang	1 lb + 4 oz	13.7 bc	6.4 d	20.1 ef
Lannate+Mustang	0.75 lb +4 oz	11.1 c	5.7 d	16.8 f
Dimethoate	12 oz	21.8 a	20.1 bc	41.9 bc
Endosulfan	1.33 qt	21.4 a	12.9 cd	34.3 bcd
Untreated	-	22.8 a	54.3 a	77.1 a

Mean followed by the same letter are not significantly different ($LSD_{p<0.05}$)

Trial 3. Interactions between Aphid and Thrips Control in Head Lettuce I -2003

Tests Location: Yuma Agricultural Center, Yuma, Arizona

Crop: Lettuce, *Lactuca sativa* L. ' Bubba'

Planting date: Nov 14, 2002

Irrigation: Sprinkler irrigation at stand establishment; furrow irrigated thereafter

Experimental Design Four beds wide by 50 ft long (two seed lines/ beds; 42 "centers); bordered by two untreated beds. Four replications of each treatment in a randomized complete block design. Aphid treatments were assigned to main plots and thrips treatments were assigned to sub plots (see plot plan below).

Main Plots	**Sub Plots**			
Soil-Admire	*Conventional*	*Reduced-risk*	*Untreated*	**I**
Foliar -New	*Reduced-risk*	*Conventional*	*Untreated*	
Foliar -Old	*Untreated*	*Reduced-risk*	*Conventional*	
Untreated	*Conventional*	*Untreated*	*Reduced-risk*	
Foliar -New	*Untreated*	*Reduced-risk*	*Conventional*	**II**
Untreated	*Conventional*	*Untreated*	*Reduced-risk*	
Foliar -Old	*Reduced-risk*	*Conventional*	*Untreated*	
Soil-Admire	*Reduced-risk*	*Untreated*	*Conventional*	
Untreated	*Untreated*	*Reduced-risk*	*Conventional*	**III**
Foliar -New	*Conventional*	*Reduced-risk*	*Untreated*	
Soil-Admire	*Conventional*	*Untreated*	*Reduced-risk*	
Foliar -Old	*Reduced-risk*	*Conventional*	*Untreated*	

Main Plots – Aphid Control	**Treatment (rate/ac)**	**Application dates**
Soil - Admire	Admire 2F (16 oz)	At planting – Nov 14
Foliar -New	1. Actara (4.0 oz) 2. Fulfill (2.75 oz) 3. Assail (1.7 oz)	1. Jan 10 2. Jan 27 3. Feb 10
Foliar -Old	1. Orthene (1.0 lb) 2. Orthene + Provado (1.0 lb + 3.75 oz) 3. Dimethoate + Thiodan (12 oz + 32 oz)	
Sub Plots – Thrips Control		
Conventional	Lannate (0.8 lb)+ Mustang (4 oz)	1. Jan 9 2. Jan 31 3. Feb 15
Reduced-risk	Success (6 oz)	

Application Procedures: Foliar applications were made with a CO_2 operated boom sprayer operated at 60 psi and 27 GPA. A directed spray (nozzles directed toward the plants) was delivered through 3 nozzles (TX-10) per bed. An adjuvant was applied to all foliar treatments, either Kinetic at 0.06% v/v, DyneAmic at 0.125% v/v or Hook at 0.125% v/v. A total of 3 separate aphid sprays and 3 thrips sprays were applied (see above for dates).

The first aphid spray was initiated at early aphid colonization – 0.9 aphids / plant (0.2 FG, and 0.7 GPA aphids / plant; 7 % of the plants were infested with at least 1 aphid). Thrips populations at first application were beginning to colonize (3.3 adults/ plant and 4.8 larvae / plant).

Evaluation Procedures:

Aphid populations were assessed by estimating the number of aphids /plant in whole plant, destructive samples. Four aphid species were present on plants during the test; Foxglove aphid (FG), Potato aphid (PA), *Acyrthosiphon lactucae* (AL), Lettuce aphid (LA) and Green peach aphid (GPA). On each sampling date, 10 plants were randomly selected from each plot and placed individually into large 3-gal tubs. Each plant was sampled by visually examining all plant foliage and counting the number of alate and apterous aphids present. At harvest (Mar 6), infestation levels of apterous aphids were estimated by randomly selecting 10 plants within each replicate, visually counting the number of aphids on frame/wrapper leaves and heads.

Thrips control was based on the number of live adults and nymphs per plant sampled from the center 2 rows of each replicate at intervals following each application. Numbers of thrips adults and larvae from 3 plants per replicate were recorded on each sample. Samples were taken by removing plants and beating them vigorously against a screened pan for a predetermined duration. Inside of the pan was a sticky trap to catch the dislodged thrips. Sticky traps were then taken to the laboratory where adult and larvae were counted. Data was analyzed using ANOVA and mean differences were estimated using a protected $LSD_{(0.05)}$ or a paired t $test_{(p< 0.05)}$.

Aphid * Thrips Efficacy – pre heading **Jan 24**

		Apterous aphids (mean / plant)				
Aphid treatments	**Thrips treatments**	**FG**	**PA/AL**	**GPA**	**LA**	**Total**
Soil - Admire	Untreated	0	0	0 b	0	0
Soil - Admire	Conventional	0.3	0	0 b	0	0.3
Soil - Admire	Reduced-risk	0.1	0	0 b	0	0.1
Foliar -New	Untreated	0.3	0	0 b	0	0.3
Foliar -New	Conventional	0.9	0	0 b	0	0.9
Foliar -New	Reduced-risk	0.3	0	0.1 b	0	0.4
Foliar -Old	Untreated	0.3	0	0 b	0	0.3
Foliar -Old	Conventional	0.5	0	0.1 b	0	0.6
Foliar -Old	Reduced-risk	0	0.3	0 b	0	0.3
Untreated	Untreated	1.7	1.1	0.5 b	0	3.3
Untreated	Conventional	0.6	0.6	0.1 b	0	1.3
Untreated	Reduced-risk	0.5	0	9.2 a	0	9.7

* no significant differences among treatments

		Alate aphids (mean / plant)				
Aphid treatments	**Thrips treatments**	**FG**	**PA/AL**	**GPA**	**LA**	**Total**
Soil - Admire	Untreated	0	0.1	0	0	0.1
Soil - Admire	Conventional	0.1	0	0	0	0.1
Soil - Admire	Reduced-risk	0	0	0	0	0
Foliar -New	Untreated	0.1	0	0	0	0.1
Foliar -New	Conventional	0.1	0.1	0	0	0.2
Foliar -New	Reduced-risk	0.1	0	0.1	0	0.2
Foliar -Old	Untreated	0	0.1	0	0	0.1
Foliar -Old	Conventional	0	0.1	0.1	0	0.2
Foliar -Old	Reduced-risk	0	0.1	0	0	0.1
Untreated	Untreated	0.1	0	0	0	0.1
Untreated	Conventional	0.1	0.1	0	0	0.2
Untreated	Reduced-risk	0.1	0	0.1	0	0.2

* no significant differences among treatments

Aphid * Thrips Efficacy - early heading **Feb 10**

Aphid treatments	Thrips treatments	Apterous aphids (mean / plant)				
		FG	PA/AL	GPA	LA	Total
Soil - Admire	Untreated	2.5 b	0.1 a	0 c	0.3 a	2.9 b
Soil - Admire	Conventional	2.2 b	0 a	0 c	0 a	2.2 b
Soil - Admire	Reduced-risk	1.9 b	0 a	0 c	0 a	1.9 b
Foliar -New	Untreated	0.4 b	0 a	0 c	0 a	0.4 b
Foliar -New	Conventional	0.7 b	0 a	0 c	0 a	0.7 b
Foliar -New	Reduced-risk	1.8 b	0 a	0 c	0 a	1.8 b
Foliar -Old	Untreated	0.1 b	0.3 a	0 c	0 a	0.5 b
Foliar -Old	Conventional	0 b	0 a	0 c	0 a	0 b
Foliar -Old	Reduced-risk	0 b	0.1 a	0 c	0 a	0.1 b
Untreated	Untreated	20.1 a	3.3 a	0.5 ab	7.4 a	31.3 a
Untreated	Conventional	3.5 b	3.2 a	0.3 bc	0 a	7.0 b
Untreated	Reduced-risk	1.9 b	0 a	0.8 a	0 a	2.7 b

Mean followed by the same letter are not significantly different ($LSD_{p<0.05}$)

Aphid treatments	Thrips treatments	Alate aphids (mean / plant)				
		FG	PA/AL	GPA	LA	Total
Soil - Admire	Untreated	0.3 a	0 a	0 a	0 a	0.3 a
Soil - Admire	Conventional	0.4 a	0 a	0 a	0 a	0.3 a
Soil - Admire	Reduced-risk	0.2 a	0.1 a	0 a	0 a	0.4 a
Foliar -New	Untreated	0.1 a	0 a	0 a	0 a	0.1 a
Foliar -New	Conventional	0 a	0 a	0 a	0 a	0 a
Foliar -New	Reduced-risk	0.1 a	0.1 a	0 a	0 a	0.2 a
Foliar -Old	Untreated	0 a	0 a	0 a	0 a	0 a
Foliar -Old	Conventional	0 a	0 a	0a	0 a	0 a
Foliar -Old	Reduced-risk	0 a	0 a	0 a	0.1 a	0.1 a
Untreated	Untreated	0.1 a	0.1 a	0 a	0.1 a	0.3 a
Untreated	Conventional	0 a	0.1 a	0.1 a	0 a	0.2 a
Untreated	Reduced-risk	0.1 a	0 a	0.1 a	0 a	0.1 a

* no significant differences among treatments

Aphid * Thrips Efficacy **Mar 3 - Harvest Evaluation**

		Foxglove Aphid (mean / plant)					
		Winged forms			Colonizing forms		
Aphid Treatment	**Thrips Treatment**	**Wrappers**	**Heads**	**Total**	**Wrappers**	**Heads**	**Total**
Soil - Admire	Untreated	0.3 a	0.1a	0.4 a	22.2 c	11.9 b	34.1 bc
Soil - Admire	Conventional	0.8 a	0.1 a	0.9 a	19.9 cd	4.7 bcd	24.6 bcd
Soil - Admire	Reduced-risk	0.6 a	0.1 a	0.7 a	47.2 bc	12.0 b	59.2 b
Foliar -New	Untreated	0.2 a	0.2 a	0.4 a	8.7 de	5.2 bcd	13.9 de
Foliar -New	Conventional	0.7 a	0.3 a	1.0 a	6.4 e	6.1 bc	12.5 de
Foliar -New	Reduced-risk	1.2 a	0.1 a	1.3 a	6.9 de	2.4 cd	9.3 def
Foliar -Old	Untreated	0.4 a	0.2 a	0.6 a	3.0 e	0.9 d	3.9 f
Foliar -Old	Conventional	0.8 a	0.3 a	1.1 a	2.6 e	2.2 cd	4.8 ef
Foliar -Old	Reduced-risk	0.6 a	0.4 a	1.0 a	6.8 de	7.6 bc	14.4 bcd
Untreated	Untreated	3.5 a	1.4 a	4.9 a	211.4 a	77.9 a	288.3 a
Untreated	Conventional	0.9 a	0.3 a	1.2 a	43.4 bc	13.7 b	57.1 b
Untreated	Reduced-risk	1.6 a	0.8 a	2.4 a	96.0 ab	75.4 a	161.4 a

Mean followed by the same letter are not significantly different (LSD $_{p<0.05}$)

		Potato Aphid / *A. lactucae* (mean / plant)					
		Winged forms			Colonizing forms		
Aphid Treatment	**Thrips Treatment**	**Wrappers**	**Heads**	**Total**	**Wrappers**	**Heads**	**Total**
Soil - Admire	Untreated	0.1 a	0.2 a	0.3 a	0.8 cde	0.4 b	1.2 bc
Soil - Admire	Conventional	0.1 a	0 a	0.1 a	1.1 cd	0 b	1.1 bc
Soil - Admire	Reduced-risk	0.1 a	0 a	0.1 a	0.3 de	0 b	0.3 bc
Foliar -New	Untreated	0.1 a	0 a	0.1 a	0.2	0.7 b	0.9 bc
Foliar -New	Conventional	0.1 a	0.1 a	0.2 a	0.4 cde	0.4 b	0.8 bc
Foliar -New	Reduced-risk	0.1 a	0 a	0.1 a	0.5 cde	0 b	0.5 bc
Foliar -Old	Untreated	0 a	0.1 a	0.1 a	0.1 e	0.1 b	0.2 c
Foliar -Old	Conventional	0 a	0 a	0 a	0 e	0 b	0 c
Foliar -Old	Reduced-risk	0.1 a	0.1 a	0.2 a	0.1 e	0.1 b	0.2 c
Untreated	Untreated	1.6 a	0.8 a	2.4 a	86.0 a	20.3 a	96.3 a
Untreated	Conventional	0.3 a	0 a	0.3 a	1.4 c	0.1 b	1.5 b
Untreated	Reduced-risk	0.5 a	0a	0.5 a	43.5 b	22.0 a	65.5 a

Mean followed by the same letter are not significantly different (LSD $_{p<0.05}$)

Aphid * Thrips Efficacy **Mar 3 - Harvest Evaluation**

		Green Peach Aphid (mean / plant)					
		Winged forms			Colonizing forms		
Aphid Treatment	**Thrips Treatment**	**Wrappers**	**Heads**	**Total**	**Wrappers**	**Heads**	**Total**
Soil - Admire	Untreated	0.1 a	0.1 a	0.1 a	0 c	0 c	0 d
Soil - Admire	Conventional	0.3 a	0.1 a	0.4 a	0.1 c	0 c	0.1 cd
Soil - Admire	Reduced-risk	0.1 a	0 a	0.1 a	0.3 bc	0 c	0.3 cd
Foliar -New	Untreated	0 a	0 a	0 a	0 c	0 c	0 d
Foliar -New	Conventional	0.6 a	0 a	0.6 a	0.1 c	0 c	0.1 cd
Foliar -New	Reduced-risk	0.1 a	0.1 a	0.2 a	0.2 c	0 c	0.2 cd
Foliar -Old	Untreated	0.2 a	0.1 a	0.3 a	0.3 bc	0 c	0.3 bcd
Foliar -Old	Conventional	0.2 a	0 a	0.2 a	0.3 bc	0.1 bc	0.4 bcd
Foliar -Old	Reduced-risk	0.3 a	0.1 a	0.4 a	1.3 bc	0.4 b	1.7 bc
Untreated	Untreated	0 a	0 a	0 a	1.5 b	0 c	1.5 b
Untreated	Conventional	0.3 a	0 a	0.3 a	0.8 bc	0 c	0.8 bcd
Untreated	Reduced-risk	0.4 a	0.3a	0.7 a	20.6 a	1.1 a	21.7 a

Mean followed by the same letter are not significantly different (LSD $_{p<0.05}$)

		Lettuce Aphid (mean / plant)					
		Winged forms			Colonizing forms		
Aphid Treatment	**Thrips Treatment**	**Wrappers**	**Heads**	**Total**	**Wrappers**	**Heads**	**Total**
Soil - Admire	Untreated	0 a	0 a	0 a	0.1 a	2.0 a	2.1 a
Soil - Admire	Conventional	0 a	0 a	0 a	0 a	0 a	0 a
Soil - Admire	Reduced-risk	0 a	0 a	0 a	0 a	0.9 a	0.9 a
Foliar -New	Untreated	0 a	0.1 a	0.1 a	0.2 a	0.8 a	1.0 a
Foliar -New	Conventional	0 a	0 a	0 a	0 a	0 a	0a
Foliar -New	Reduced-risk	0.1 a	0 a	0.1 a	0.1 a	0.2 a	0.3 a
Foliar -Old	Untreated	0.1 a	0 a	0.1 a	0.8 a	0.3 a	1.1 a
Foliar -Old	Conventional	0.1 a	0.1 a	0.2 a	0 a	0 a	0 a
Foliar -Old	Reduced-risk	0 a	0 a	0 a	0 a	0.5 a	0.5 a
Untreated	Untreated	0.3 a	0 a	0.3 a	6.7 a	8.0 a	14.7a
Untreated	Conventional	0 a	0 a	0 a	0 a	0 a	0 a
Untreated	Reduced-risk	2.4 a	1.5 a	3.9 a	33.6 a	24.8 a	58.4 a

Mean followed by the same letter are not significantly different (LSD $_{p<0.05}$)

Aphid * Thrips Efficacy **Mar 3 - Harvest Evaluation**

		Total Aphids (mean / plant)					
		Winged forms			Colonizing forms		
Aphid Treatment	**Thrips Treatment**	**Frame**	**Heads**	**Total**	**Frame**	**Heads**	**Total**
Soil - Admire	Untreated	0.4 c	0.4 a	0.8 c	23.1 b	14.3 b	37.3 bc
Soil - Admire	Conventional	1.1 bc	0.1 a	1.2 c	21.1 bc	4.7 cde	25.7 bcd
Soil - Admire	Reduced-risk	0.8 c	0.1 a	0.9 c	47.8 b	12.9 bc	60.8 b
Foliar -New	Untreated	0.3 c	0.2 a	0.5 c	9.1 cd	6.6 bcd	15.7 def
Foliar -New	Conventional	1.3 bc	0.4 a	1.7 bc	6.9 d	6.5 bcde	13.4 def
Foliar -New	Reduced-risk	1.5 abc	0.2 a	1.7 bc	7.6 d	2.7 de	10.3 def
Foliar -Old	Untreated	0.7 c	0.3 a	1.0 c	4.2 d	1.4 e	5.6 ef
Foliar -Old	Conventional	1.0 bc	0.3 a	1.3 c	2.9 d	2.3 de	5.2 f
Foliar -Old	Reduced-risk	1.0 bc	0.6 a	1.6 bc	8.2 cd	8.6 bcd	16.8 cde
Untreated	Untreated	4.2 ab	1.4 a	5.6 ab	299.9 a	96.0 a	395.3 a
Untreated	Conventional	1.5 abc	0.3a	1.8 bc	45.5 b	13.8 bc	59.3 b
Untreated	Reduced-risk	4.9 a	2.6 a	7.5 a	183.3 a	123.3 a	306.6 a

Mean followed by the same letter are not significantly different ($LSD_{p<0.05}$)

Aphid * Thrips Efficacy

Jan 15

		Mean Thrips / Plant		
Aphid Treatment	**Thrips Treatment**	**Adults**	**Larvae**	**Total**
Soil - Admire	Untreated	15.8 a	13.1 a	28.9 a
Soil - Admire	Conventional	3.8 cd	5.1 cd	8.8 cd
Soil - Admire	Reduced-risk	6.3 bcd	6.3 bcd	12.7 bcd
Foliar -New	Untreated	6.8 bc	9.8 abc	16.6 bc
Foliar -New	Conventional	2.9 cd	5.0 cd	7.8 cd
Foliar -New	Reduced-risk	3.9 cd	8.3 abcd	12.2 bcd
Foliar -Old	Untreated	1.9 cd	5.1 cd	7.0 d
Foliar -Old	Conventional	1.2 d	5.3 cd	6.6 d
Foliar -Old	Reduced-risk	3.2 cd	4.0 d	7.2 d
Untreated	Untreated	10.1 a	10.8 ab	20.9 ab
Untreated	Conventional	1.8 cd	9.7 abc	8.0 cd
Untreated	Reduced-risk	5.1 bcd	6.2 bcd	14.8 bcd

Mean followed by the same letter are not significantly different ($LSD_{p<0.05}$)

Jan 29

		Mean Thrips / Plant		
Aphid Treatment	**Thrips Treatment**	**Adults**	**Larvae**	**Total**
Soil - Admire	Untreated	16.8 a	71.4 a	88.2 a
Soil - Admire	Conventional	11.7 b	11.7 b	23.4 b
Soil - Admire	Reduced-risk	13.2 ab	11.6 b	24.8 b
Foliar -New	Untreated	12.9 ab	22.2 b	35.1 b
Foliar -New	Conventional	9.4 bc	6.3 b	15.8 b
Foliar -New	Reduced-risk	10.2 b	10.1 b	20.3 b
Foliar -Old	Untreated	4.4 d	5.8 b	10.2 b
Foliar -Old	Conventional	5.4 cd	3.2 b	8.7 b
Foliar -Old	Reduced-risk	5.4 cd	4.4 b	9.9 b
Untreated	Untreated	12.4 b	60.6 a	73.0 a
Untreated	Conventional	10.7 b	8.4 b	19.1 b
Untreated	Reduced-risk	9.9 b	8.8 b	18.7 b

Mean followed by the same letter are not significantly different ($LSD_{p<0.05}$)

Aphid * Thrips Efficacy **Feb 11**

		Mean Thrips / Plant		
Aphid Treatment	**Thrips Treatment**	**Adults**	**Larvae**	**Total**
Soil - Admire	Untreated	40.3 a	65.2 a	105.6 a
Soil - Admire	Conventional	11.1 cd	14.0 c	25.1 d
Soil - Admire	Reduced-risk	20.8 bc	20.0 c	40.8 cd
Foliar -New	Untreated	35.9 a	30.0 bc	65.9 bc
Foliar -New	Conventional	7.9 d	11.6 c	19.4 d
Foliar -New	Reduced-risk	21.1 b	19.2 c	40.3 cd
Foliar -Old	Untreated	4.1 d	7.3 c	11.4 d
Foliar -Old	Conventional	4.6 d	8.7 c	13.2 d
Foliar -Old	Reduced-risk	7.0 d	6.0 c	13.0 d
Untreated	Untreated	37.1 a	56.6 ab	93.7 ab
Untreated	Conventional	8.3 d	10.2 c	18.6 d
Untreated	Reduced-risk	20.6 bc	17.0 c	37.6 cd

Feb 24

		Mean Thrips / Plant		
Aphid Treatment	**Thrips Treatment**	**Adults**	**Larvae**	**Total**
Soil - Admire	Untreated	28.3 a	99.8 a	128.1 a
Soil - Admire	Conventional	4.1 c	13.2 c	17.3 c
Soil - Admire	Reduced-risk	10.0 c	16.4 c	26.4 c
Foliar -New	Untreated	24.9 ab	73.8 ab	98.7 ab
Foliar -New	Conventional	4.7 c	8.2 c	12.9 c
Foliar -New	Reduced-risk	10.1 c	15.9 c	26.0 c
Foliar -Old	Untreated	18.2 b	15.8 c	34.0 c
Foliar -Old	Conventional	7.2 c	4.4 c	11.7 c
Foliar -Old	Reduced-risk	6.4 c	4.2 c	10.7 c
Untreated	Untreated	27.1 a	67.8 b	94.9 b
Untreated	Conventional	4.7 c	9.6 c	14.2 c
Untreated	Reduced-risk	6.6 c	12.9 c	19.4 c

Mean followed by the same letter are not significantly different ($LSD_{p<0.05}$)

Trial 4. Interactions between Aphid and Thrips Control in Head Lettuce II -2003

Test Location: Yuma Agricultural Center, Yuma, Arizona

Crop: Lettuce, *Lactuca sativa* L. ' Desert Spring'

Planting /wet Date: Dec 12, 2002

Irrigation: Sprinkler irrigation at stand establishment; furrow irrigated thereafter

Replicate size: Four beds wide by 50 ft long (two seed lines/ beds; 42 " centers); bordered by two untreated beds. Four replications of each treatment in a randomized complete block design. Aphid treatments were assigned to main plots and thrips treatmenst were assigned to sub plots (see plot plan below).

Main Plots	**Sub Plots**			
Soil-Admire	*Conventional*	*Reduced-risk*	*Untreated*	
Foliar -New	*Reduced-risk*	*Conventional*	*Untreated*	
Foliar -Old	*Untreated*	*Reduced-risk*	*Conventional*	**I**
Untreated	*Conventional*	*Untreated*	*Reduced-risk*	
Foliar -New	*Untreated*	*Reduced-risk*	*Conventional*	
Untreated	*Conventional*	*Untreated*	*Reduced-risk*	
Foliar -Old	*Reduced-risk*	*Conventional*	*Untreated*	**II**
Soil-Admire	*Reduced-risk*	*Untreated*	*Conventional*	
Untreated	*Untreated*	*Reduced-risk*	*Conventional*	
Foliar -New	*Conventional*	*Reduced-risk*	*Untreated*	
Soil-Admire	*Conventional*	*Untreated*	*Reduced-risk*	**III**
Foliar -Old	*Reduced-risk*	*Conventional*	*Untreated*	

Aphid Control	**Thrips Control**	**Spray #1 (Feb 6)**	**Spray #2 (Feb 18)**	**Spray #3 (Mar 4)**
Soil	Untreated	--	--	--
	Conv	Lannate (0.8 lb)/Mustang (4 oz)	Lannate/Mustang	Lannate/Mustang
	Red-risk	Success (6 oz)	Success	Success
New	Untreated	Fulfill (2.75 oz)	Assail (1.7 oz)	Actara (4.0 oz)
	Conv	Fulfill /Lannate+Mustang Max	Assail/Lannate/Mustang Max	Actara / Lannate+Mustang Max
	Red-risk	Fulfill / Success	Assail/Success	Actara / Success
Old	Untreated	Orthene (1 lb)/Dimethoate (12 oz)	Provado (3.8 oz)/Capture (5 oz)	Dimethoate (12 oz)/Mustang Max (4 oz)
	Conv	Orthene/Dimethoate/Lannate/Mustang	Provado/Capture/ Lannate	Dimethoate/Mustang Max / Lannate
	Red-risk	Orthene/Dimethoate/Success	Provado/Capture/ Success	Dimethoate/Mustang Max /Success
Untreated	Untreated	--	--	--
	Conv	Lannate/Mustang	Lannate/Mustang	Lannate/Mustang
	Red-risk	Success	Success	Success

Application Procedures:

Foliar applications were made with a CO_2 operated boom sprayer operated at 60 psi and 27 GPA. A directed spray (nozzles directed toward the plants) was delivered through 3 nozzles (TX-10) per bed. Sprays were applied on Feb 6, 18 and Mar 4. An adjuvant was applied to all foliar treatments, either Kinetic at 0.06% v/v, DyneAmic at 0.125% v/v or Hook at 0.125% v/v. A total of 3 sprays were applied (see above) with both aphid and thrips treatments combined and applied on the same date.

The first aphid spray was initiated at early aphid colonization – 0.5 aphids / plant (0.1 FG, and 0.4 PA/AL aphids / plant; 10 % of the plants were infested with at least 1 aphid). Thrips populations at first application were beginning to colonize (1.4 adults/ plant and 1.3 larvae / plant).

Evaluation Procedures:

Aphid populations were assessed by estimating the number of aphids /plant in whole plant, destructive samples. Four aphid species were present on plants during the test; Foxglove aphid (FG), Potato aphid (PA), *Acyrthosiphon lactucae* (AL), Lettuce aphid (LA) and Green peach aphid (GPA). On each sampling date, 10 plants were randomly selected from each plot and placed individually into large 3-gal tubs. Each plant was sampled by visually examining all plant foliage and counting the number of alate and apterous aphids present. At harvest (Mar 6), infestation levels of apterous aphids were estimated by randomly selecting 10 plants within each replicate, visually counting the number of aphids on frame/wrapper leaves and heads.

Thrips control was based on the number of live adults and nymphs per plant sampled from the center 2 rows of each replicate at intervals following each application. Numbers of thrips adults and larvae from 3 plants per replicate were recorded on each sample. Samples were taken by removing plants and beating them vigorously against a screened pan for a predetermined duration. Inside of the pan was a sticky trap to catch the dislodged thrips. Sticky traps were then taken to the laboratory where adult and larvae were counted. Data was analyzed using ANOVA and mean differences were estimated using a protected $LSD_{(0.05)}$ or a paired t test$_{(p< 0.05)}$.

Aphid * Thrips Efficacy – pre heading **Feb 27**

Aphid treatments	Thrips treatments	Apterous aphids (mean / plant)				
		FG	PA/AL	GPA	LA	Total
Admire	Untreated	11.0 bcd	0.2 cd	0.5 a	1.1 a	12.8 bc
Admire	Conventional	6.4 bcde	0.1 d	0 a	0 a	6.5 c
Admire	Reduced-risk	8.3 bcd	0.1 d	0.1 a	0 a	8.5 c
Foliar -New	Untreated	1.9 f	0.4 bcd	0.1 a	0.1 a	2.5 c
Foliar -New	Conventional	4.3 cdef	2.6 abcd	0.3 a	0 a	7.2 c
Foliar -New	Reduced-risk	4.3 cdef	4.3 ab	0.4 a	0.1 a	9.1 bc
Foliar -Old	Untreated	2.7 ef	0.2 cd	0.1 a	0.1 a	3.0 c
Foliar -Old	Conventional	2.7 ef	0.1 d	0.4 a	0 a	3.2 c
Foliar -Old	Reduced-risk	3.9 def	0.2 cd	0.2 a	0 a	4.3 c
Untreated	Untreated	34.2 a	14.5 a	0.5 a	30.6 a	79.8 a
Untreated	Conventional	16.0 ab	26.2 a	0.4a	0 a	42.6 ab
Untreated	Reduced-risk	13.2 abc	16.2 a	0.5 a	3.3 a	33.2 ab

Mean followed by the same letter are not sifgnificantly different (LSD $_{p<0.05}$)

Aphid treatments	Thrips treatments	Alate aphids (mean / plant)				
		FG	PA/AL	GPA	LA	Total
Admire	Untreated	0.8	0.1	0.3	0.1	1.2
Admire	Conventional	0.9	0	0.3	0	1.2
Admire	Reduced-risk	1.1	0.1	0.5	0	1.7
Foliar -New	Untreated	0.5	0.1	0.5	0	1.1
Foliar -New	Conventional	0.7	0.1	0.5	0.1	1.3
Foliar -New	Reduced-risk	0.7	0.3	0.9	0.1	1.9
Foliar -Old	Untreated	0.5	0	0.3	0	0.8
Foliar -Old	Conventional	0.8	0.1	0.1	0	1.0
Foliar -Old	Reduced-risk	0.6	0	0.5	0	1.1
Untreated	Untreated	0.6	0	0.5	0	1.1
Untreated	Conventional	0.8	0	0.1	0	0.9
Untreated	Reduced-risk	0.9	0	0.7	0	1.5

* no significant differences among treatments

Aphid * Thrips Efficacy **Mar 14 - Harvest Evaluation**

		Foxglove Aphid (mean / plant)					
		Winged forms			Colonizing forms		
Aphid Treatment	**Thrips Treatment**	**Frame**	**Heads**	**Total**	**Frame**	**Heads**	**Total**
Admire	Untreated	0.9 abc	0 a	0.9	78.2 b	18.9 ab	97.1 b
Admire	Conventional	1.7 a	0.5 a	2.2	198.4 ab	6.7 bc	205.1 ab
Admire	Reduced-risk	1.4 ab	0.3 a	1.7	212.3 ab	12.8 abc	225.1 ab
Foliar -New	Untreated	0.3 c	0.5 a	0.8	7.0 cd	4.5 cd	11.5 cd
Foliar -New	Conventional	0.5 bc	0.1 a	0.6	6.6 d	0.7 e	7.3 d
Foliar -New	Reduced-risk	1.1 ab	0.1 a	1.2	19.1 cd	0.9 e	20.1 cd
Foliar -Old	Untreated	0.3 c	0.1 a	0.4	8.0 cd	1.9 de	9.9 cd
Foliar -Old	Conventional	0.8 abc	0.2 a	1.0	23.9 c	1.1 e	24.9 c
Foliar -Old	Reduced-risk	0.6 bc	0.3 a	0.9	9.7 cd	0.9 e	10.6 cd
Untreated	Untreated	1.3 ab	0.2 a	1.5	239.9 ab	31.3 a	271.3 ab
Untreated	Conventional	2.0 a	0.1 a	2.1	144.0 b	9.3 bc	153.3 b
Untreated	Reduced-risk	1.8 a	0.9 a	2.7	420.6 a	30.0 a	450.6 ab

Mean followed by the same letter are not sifgnificantly different (LSD $_{p<0.05}$)

		Potato Aphid (mean / plant)					
		Winged forms			Colonizing forms		
Aphid Treatment	**Thrips Treatment**	**Frame**	**Heads**	**Total**	**Frame**	**Heads**	**Total**
Admire	Untreated	0.5 b	0.5 a	1.0	10.6 b	2.9 b	13.5 b
Admire	Conventional	0.5 b	0.2 a	0.7	0.9 c	0.8 bc	1.7 c
Admire	Reduced-risk	0.5 b	0.6 a	1.1	9.7 b	0.5 bc	10.2 b
Foliar -New	Untreated	0.3 c	0.1 a	0.4	1.3 c	0.3 c	1.6 c
Foliar -New	Conventional	0.1 c	0.1a	0.2	0.5 c	0 c	0.5 c
Foliar -New	Reduced-risk	0.1 c	0.2 a	0.3	0 c	0.1 c	0.1 c
Foliar -Old	Untreated	0 c	0 a	0	0.2 c	0 c	0.2 c
Foliar -Old	Conventional	0.1 c	0 a	0.1	0 c	0 c	0 c
Foliar -Old	Reduced-risk	0.1 c	0 a	0.1	0.4 c	0 c	0.4 c
Untreated	Untreated	1.9 a	0.2 a	2.1	466.4 a	42.3 a	508.7 a
Untreated	Conventional	0.6 b	0.2 a	0.8	39.5 b	1.2 bc	40.7 b
Untreated	Reduced-risk	0.9 ab	0.2 a	1.1	246.1 a	22.3 a	268.3 a

Mean followed by the same letter are not sifgnificantly different (LSD $_{p<0.05}$)

Aphid * Thrips Efficacy **Mar 14 - Harvest Evaluation**

		Green Peach Aphid (mean / plant)					
		Winged forms			Colonizing forms		
Aphid Treatment	**Thrips Treatment**	**Frame**	**Heads**	**Total**	**Frame**	**Heads**	**Total**
Admire	Untreated	0.2	0	0.2	0.3	0	0.3
Admire	Conventional	0.1	0	0.1	0	0	0
Admire	Reduced-risk	0	0.1	0.1	0	0	0
Foliar -New	Untreated	0	0	0	0	0	0
Foliar -New	Conventional	0	0	0	0	0	0
Foliar -New	Reduced-risk	0.2	0.1	0.3	0	0	0
Foliar -Old	Untreated	0.1	0.1	0.2	0	0	0
Foliar -Old	Conventional	0	0	0	0	0	0
Foliar -Old	Reduced-risk	0.1	0	0.1	0	0	0
Untreated	Untreated	0.1	0	0.1	0.3	0	0.3
Untreated	Conventional	0.2	0.3	0.5	0.5	0.1	0.6
Untreated	Reduced-risk	0.1	0	0.1	0	0.1	0.1

* No significant differences among treatments

		Lettuce Aphid (mean / plant)					
		Winged forms			Colonizing forms		
Aphid Treatment	**Thrips Treatment**	**Frame**	**Heads**	**Total**	**Frame**	**Heads**	**Total**
Admire	Untreated	0 a	0.1 a	0.1 a	0.2 b	1.5 b	1.7 b
Admire	Conventional	0 a	0.1 a	0.1 a	0 b	0.4 b	0.4 b
Admire	Reduced-risk	0 a	0 a	0 a	2.0 b	4.1 b	6.1 b
Foliar -New	Untreated	0 a	0 a	0 a	0 b	0 b	0 b
Foliar -New	Conventional	0 a	0 a	0 a	0 b	0 b	0 b
Foliar -New	Reduced-risk	0 a	0 a	0 a	0 b	0 b	0 b
Foliar -Old	Untreated	0 a	0 a	0 a	0 b	0 b	0 b
Foliar -Old	Conventional	0 a	0 a	0 a	0 b	0 b	0 b
Foliar -Old	Reduced-risk	0 a	0 a	0 a	0 b	0 b	0 b
Untreated	Untreated	0.6 a	0.6 a	1.2 a	46.6 a	47.9 a	94.5 a
Untreated	Conventional	0 a	0 a	0 a	0.1 b	0 b	0.1 b
Untreated	Reduced-risk	0a	0a	0 a	3.5 b	5.3 b	8.8 b

Mean followed by the same letter are not sifgnificantly different (LSD $_{p<0.05}$)

Aphid * Thrips Efficacy **Mar 14 - Harvest Evaluation**

		Total Aphids (mean / plant)					
		Winged forms			Colonizing forms		
Aphid Treatment	**Thrips Treatment**	**Frame**	**Heads**	**Total**	**Frame**	**Heads**	**Total**
Admire	Untreated	1.6 bcd	0.6 a	2.2 abcd	89.3 b	23.2 b	112.5 b
Admire	Conventional	2.3 ab	0.7 a	3.0 abc	199.3 b	7.9 bc	207.2 b
Admire	Reduced-risk	1.9 bc	1.0 a	2.9 abc	223.9 b	17.4 b	241.3 b
Foliar -New	Untreated	0.7 de	0.6 a	1.3 de	8.3 cd	4.8 cd	13.1 cd
Foliar -New	Conventional	0.7 de	0.1 a	0.8 de	7.1 d	0.7 e	7.9 d
Foliar -New	Reduced-risk	1.4 bcd	0.4 a	1.8 bcd	19.1 cd	1.1 e	20.2 c
Foliar -Old	Untreated	0.3 e	0.1 a	0.5 e	8.2 cd	1.9 de	10.1 cd
Foliar -Old	Conventional	0.9 de	0.2 a	1.1 cde	23.8 c	1.1 e	24.9 c
Foliar -Old	Reduced-risk	0.7 de	0.3 a	0.9 de	10.1 cd	0.9 e	11.0 cd
Untreated	Untreated	3.9 a	1.0 a	4.9 a	753.9 a	121.5 a	874.1 a
Untreated	Conventional	2.8 ab	0.6 a	3.4 ab	184.1 b	10.5 bc	194.6 b
Untreated	Reduced-risk	2.7 ab	1.1 a	3.9 ab	670.1 a	57.7 a	727.8 a

Mean followed by the same letter are not sifgnificantly different (LSD $_{p<0.05}$)

Aphid *Thrips Interaction **Feb 28**

		Mean Thrips / Plant		
Aphid Treatment	**Thrips Treatment**	**Adults**	**Larvae**	**Total**
Admire	Untreated	36.0 a	51.4 b	87.4 a
Admire	Conventional	13.7 d	6.6 c	20.3 c
Admire	Reduced-risk	16.3 cd	4.7 c	21.0 c
Foliar -New	Untreated	25.2 bc	31.1 b	56.3 b
Foliar -New	Conventional	10.2 d	4.8 c	15.0 c
Foliar -New	Reduced-risk	17.9 cd	7.0 c	24.9 c
Foliar -Old	Untreated	25.0 bc	8.3 c	33.3 c
Foliar -Old	Conventional	14.7 cd	4.0 c	18.7 c
Foliar -Old	Reduced-risk	17.9 cd	5.4 c	23.3 c
Untreated	Untreated	32.2 ab	59.1 a	91.3 a
Untreated	Conventional	14.9 cd	6.3 c	21.21 c
Untreated	Reduced-risk	18.9 cd	5.6 c	24.4 c

Mean followed by the same letter are not sifgnificantly different (LSD $_{p<0.05}$)

Trial 5. Efficacy Of Proclaim Against Western Flower Thrips In Fall Lettuce, 2002

The objective of the study was to evaluate the efficacy of Proclaim against western flower thrips when applied alone or and in combination with a pyrethroid insecticide. Lettuce was direct seeded on Sep 19 at the Yuma Valley Agricultural Center, Yuma, AZ into double row beds on 42 inch centers. Stand establishment was achieved using overhead sprinkler irrigation, and irrigated with furrow irrigation thereafter. Plots were two beds wide by 45 ft long and bordered by two untreated beds. Four replications of each treatment were arranged in a randomized complete block design. Formulations and rates for each compound are provided in the tables. Foliar applications were made with a CO_2 operated boom sprayer at 60 psi and 22.0 GPA. A directed spray (~75% band, with rate adjusted for band) was delivered through 3 nozzles (TX-18) per bed. Sprays were applied on 29 Oct and 14 Nov. Numbers of thrips adults and larvae from 5 plants per replicate were recorded at 3, 7 and 14 days after each spray treatment was applied (DAT). Relative thrips numbers were measured by removing plants and beating them vigorously against a screened pan for a predetermined time. A 6 in. by 6 in. sticky trap was placed inside of the pan to catch the dislodged thrips. Sticky traps were then taken to the laboratory where adults and larvae were counted under magnification. WFT counts were transformed ($\log_{10}$ n+1) before analysis of variance to stabilize variances that were found to be heterogeneous. Untransformed means are presented in tables. Data were analyzed as a 1-way ANOVA with means compared where appropriate using a protected LSD *F* test ($p<0.05$).

WFT populations were moderate to heavy during the trial. In general, the number of thrips adults and larvae in plots treated with Proclaim alone did not differ significantly from the untreated check on any of the post-treatment sampling dates (Tables 1-3). The addition of Mustang to the Proclaim treatment provided significant control of thrips larvae at 14 days following both treatments, and significant control of thrips adults following both applications. However, the number of thrips adults and larvae in the Proclaim+ Mustang treatment did not differ significantly from the plots treated with Mustang alone. The Success and Lannate+ Mustang treatments included in the trial as standards controlled thrips equal to or better than either the Proclaim+Mustang treatments during the trial. In conclusion, Proclaim does not appear to provide significant control of western flower thrips in fall lettuce.

Table 1. Larvae

		Mean No. Thrips Larvae / Plant						
			Application #1 (Sep 29)			Application # 2 (Oct 14)		
		Pre	3	7	14	3	7	14
Treatment	Rate/acre	Spray	DAT	DAT	DAT	DAT	DAT	DAT
Success 2F	5 oz	1.5 a	3.2 a	3.8 b	2.4 c	2.7 c	2.4 c	3.6 b
Success + Mustang	5 oz + 4 oz	1.8 a	3.2 a	2.5 b	2.3 c	4.0 bc	3.5 bc	3.4 b
Proclaim 5SG	3 oz	2.0 a	2.9 a	7.5 a	10.4 a	7.5 ab	11.2 a	10.3 a
Proclaim+ Mustang	3 oz+ 4 oz	1.2 a	5.4 a	8.0 a	3.8 bc	5.8 ab	5.6 b	4.8 b
Lannate+ Mustang	0.8 lb + 4 oz	1.6 a	1.7 a	2.9 b	1.6 c	0.9 d	1.1 d	1.8 c
Mustang	4 oz	1.6 a	3.7 a	6.3 a	7.1 ab	5.1 abc	4.3 bc	4.5 b
Untreated	--	1.8 a	5.1 a	8.6 a	13.4 a	10.2 a	7.7 ab	9.4 a

Means followed by the same letter are not significantly different, ANOVA; LSD $_{(p<0.05)}$

Table 2. Adults

		Mean No. Thrips Adults/ Plant						
			Application #1 (Sep 29)			Application # 2 (Oct 14)		
		Pre	3	7	14	3	7	14
Treatment	Rate/acre	Spray	DAT	DAT	DAT	DAT	DAT	DAT
Success 2F	5 oz	3.2 a	3.7 b	7.5 b	8.4 ab	5.7 b	3.7 b	5.1 b
Success + Mustang	5 oz + 4 oz	3.7 a	2.8 b	3.9 c	4.7 cd	2.3 c	2.7 b	5.1 b
Proclaim 5SG	3 oz	3.6 a	8.2 a	9.4 ab	8.0 abc	6.7 ab	7.6 a	6.3 ab
Proclaim+ Mustang	3 oz+ 4 oz	3.0 a	4.0 ab	5.6 bc	6.1 bcd	5.1 b	3.0 b	5.1 b
Lannate+ Mustang	0.8 lb + 4 oz	3.2 a	2.4 b	2.2 d	3.3 d	1.5 c	1.1 c	2.6 c
Mustang	4 oz	3.6 a	2.7 b	5.4 bc	4.8 cd	4.4 b	2.7 b	5.0 b
Untreated	--	3.0 a	8.0 a	13.0 a	10.0 a	11.1 a	7.0 a	9.0 a

Means followed by the same letter are not significantly different, ANOVA; LSD $_{(p<0.05)}$

Table 3. Total Thrips

		Mean No. Total Thrips / Plant						
			Application #1 (Sep 29)			Application # 2 (Oct 14)		
		Pre	3	7	14	3	7	14
Treatment	Rate/acre	Spray	DAT	DAT	DAT	DAT	DAT	DAT
Success 2F	5 oz	4.7 a	6.9 cd	11.3 c	10.9 cde	8.3 cd	6.1 b	8.7 b
Success + Mustang	5 oz + 4 oz	5.5 a	6.0 bcd	6.4 d	7.0 de	6.3 d	6.2 b	8.5 b
Proclaim 5SG	3 oz	5.6 a	11.1 ab	16.9 ab	18.3 ab	13.2 ab	18.8 a	16.7 a
Proclaim+ Mustang	3 oz+ 4 oz	4.2 a	9.4 abc	13.6 bc	9.9 cd	10.8 bc	8.6 b	9.9 b
Lannate+ Mustang	0.8 lb + 4 oz	4.8 a	4.1 d	5.1 d	4.9 e	2.4 e	2.2 c	4.4 c
Mustang	4 oz	5.2 a	6.3 bcd	11.8 bc	11.9 bc	9.5 bcd	7.0 b	9.6 b
Untreated	--	4.8 a	13.1 a	21.6 a	23.3 a	20.3 a	14.7 a	18.4 a

Means followed by the same letter are not significantly different, ANOVA; LSD $_{(p<0.05)}$